POWER TOPICS CROSS-INDEX

STEAM GENERATION
POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
PUMPS & COMPRESSORS
STEAM SERVICES
ELECTRICITY & ELEVATORS
INSTRUMENTS & CONTROL
PIPING SYSTEMS
MECHANICAL TRANSMISSION
POWER MISCELLANY

FRED. R. LOW, *Editor Emeritus*

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JANUARY, 1936

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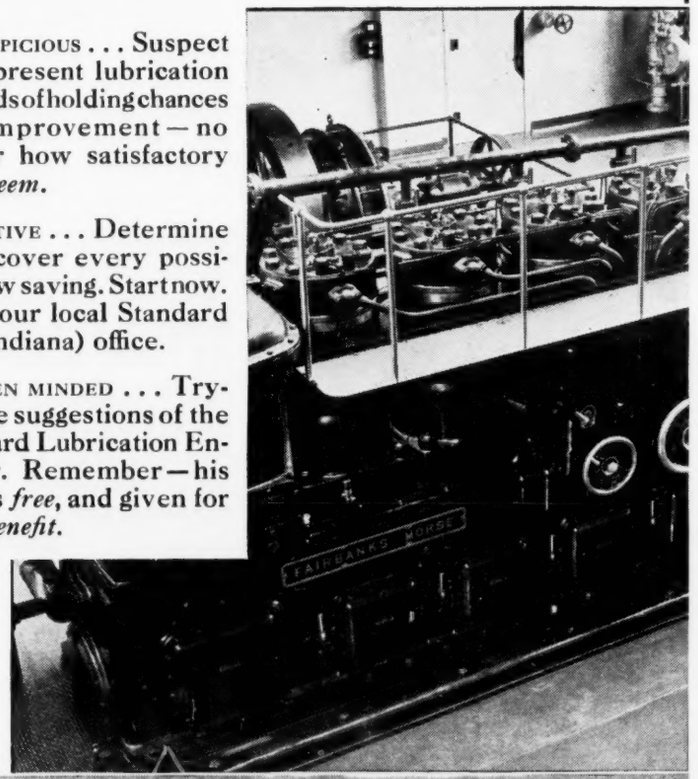

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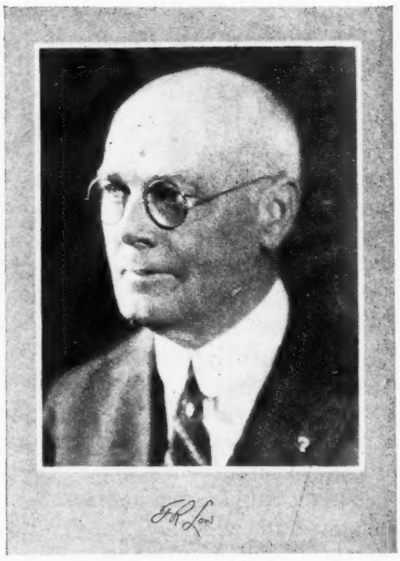
Position.....Company.....
Address.....
City.....State.....

POWER

A McGraw-Hill Publication—Established 1884
PHILIP W. SWAIN, *Editor*



Still waters run deep. Often in the past Mr. Low's quiet forewords sounded the depths of human values. They were timeless. Here in the dawn of 1936 he brings you again his New Year's greeting of 1923. Yet nothing is lost; the passage of many seasons has not made his philosophy less true or cooled the friendly warmth of his good wishes.

HAPPY NEW YEAR

• THE OLD YEAR, with all its achievements and failures, its satisfactions and disappointments, its joys and its griefs, is behind us. Its 525,600 minutes have been spent. What have we bought with them? What have we to show for it?

The new year lies before us, a clean, unwritten page, replete with possibilities. What shall the story be which it will carry into history when, a year, from now, it is turned over—into the world's history; into our life's story, yours and mine?

The real fellow is, of course, he who plays the game the best that he knows how all the time. If he has a bad inning or a bad hole, he braces up and goes after the next with all the more concentration and purpose, and refuses to be set back by misfortune or subdued into mediocrity by temporary lack of success.

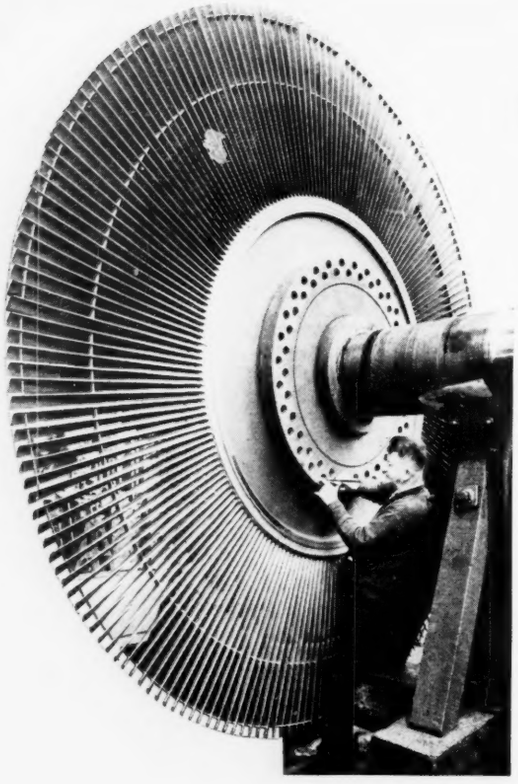
Most of us, however, get to plodding even if we do not stumble, and we welcome a pause, a turning point in the game, a chance to size up the score and take a new hold on life. And we do this at New Year's. Today is not different from a lot of other todays; this year will not be different from a lot of other years, but we are starting in with a clean slate and a new resolve to make the most of the year that is before us and so to live that as memory turns its page it will find transcribed thereon the most satisfying accomplishment and the least of sorrow and regret.

And for each and all I hope that the coming year may be replete with happiness and success.

F. R. Low

STEAM and POWER In 1935

By R. B. Purdy
Associate Editor



One of the last-stage wheels of the 165,000 kw. unit at Richmond

IN 1934, practically no generating capacity was added to central-station systems. In view of this it is gratifying to look back over 1935 and find central stations again starting power-plant construction. During the year, 312,450 kw. of new capacity has been placed in operation, and toward the close of the year orders were placed for an additional 285,000 kw. In comparison, England has on order 1,000,000 kw. of new capacity, according to Alex Dow, president of Detroit Edison Co. No new-plant central-station projects have been initiated during the year.

Utility output has been above the outputs of 1929 ever since June, and for the week ending Dec. 21 was 2,002,005 kw.-hr.—7.5% above the previous all-time record. At one time during the year, utility output was 9% over the same period in 1929. In view of this, it may be expected that utilities will order more capacity during 1936, particularly if the courts declare unconstitutional the adverse utility legislation of 1935.

Although not complete, our records show that 55 industrials installed 303,400 kw. of generating capacity. Thus, it is probably safe to say that industrials have installed as much capacity, if not more, than have central stations.

A continued trend on the part of industrials toward the use of higher pressures is plainly evident—eight plants using pressures of 600 lb. and above were installing generating equipment. They have also demonstrated a willingness to accept high steam temperatures, one plant going to 900 deg. and another to 815 deg. There is also in evidence a trend toward the increased use of economizers in the high-pressure industrial plants.

Outstanding in the central-station field is the new Port Washington station which went into operation with a single 80,000-kw. unit, and the 165,000-kw. addition to the Richmond station (Philadelphia). Port Washington is the only new central station built within the last few years operating at 1,230 lb. pressure, 825 deg. temperature on the reheat cycle. It illustrates the greater reliability of modern generating equipment, as only one boiler and one turbine were installed.

Of particular interest is the order by Appalachian Electric Power Co. of a 40,000-kw., 3,600-r.p.m. turbine to operate at 1,250 lb. pressure and 925 deg. for its plant at Logan, W. Va. This unit is over twice the size of any previous 3,600-r.p.m. turbine, and except for the experimental unit at Detroit will operate at higher steam temperature than any other turbine in the United States. It will drive a hydrogen-cooled generator.

Detroit Edison Co. completed the first phase of its modernization of Connors Creek with installation of three 30,000-kw. units and has started the second part with the order of two new 60,000-kw. units to operate at 600 lb. and 825 deg.

One of the two high-pressure industrial plants reported in last January's review went into operation—this the 10,000-kw., 1,400-lb., 760-deg. top at the Firestone plant in Akron, Ohio. The Ford 110,000-kw. addition is still under construction.

Weirton Steel is modernizing its power facilities with a new 10,000-kw. top to operate at 900-lb. pressure and 815 deg. The two boilers will be fired with pulverized coal and coke-oven gas and are designed for 400,000-lb. per hr. capacity each. The turbine will exhaust at 215 lb. pressure.

Pittsburgh Plate Glass is also adding a 900-lb. pressure, 750-deg. boiler and turbine. The boiler, fired with underfeed stoker, is expected to deliver 180,000 lb. of steam per hour to a 6,000-kw. bleeder-back-pressure turbine. Both air preheater and economizer will be installed to reduce flue-gas temperature. The unit will go into operation this year.

Other outstanding industrial installations of last year are Monsanto Chemical Co., with two 65,000-lb. per hr. boilers supplying steam at 675 lb. pressure and 750 deg. to two 5,000-kw. turbines bleeding at 350 lb.

pressure. Scott Paper Co. placed in operation a 600-lb., 735-deg. oil-fired boiler and a 3,500-kw. turbine bleeding at 275-lb. pressure. Westvaco Chlorine Products installed two 15,000-kw. turbines to operate at 400 lb. pressure.

Municipal and institutional plant building increased during the year. Twenty-five municipal plants were reported as having ordered power equipment, though details could be obtained from only ten of these. About 21,000 kw. of generating capacity was under construction in municipal plants. Work in institutional plants has been mostly in the boiler room, as only about 5,435 kw. of new generating capacity was reported under construction.

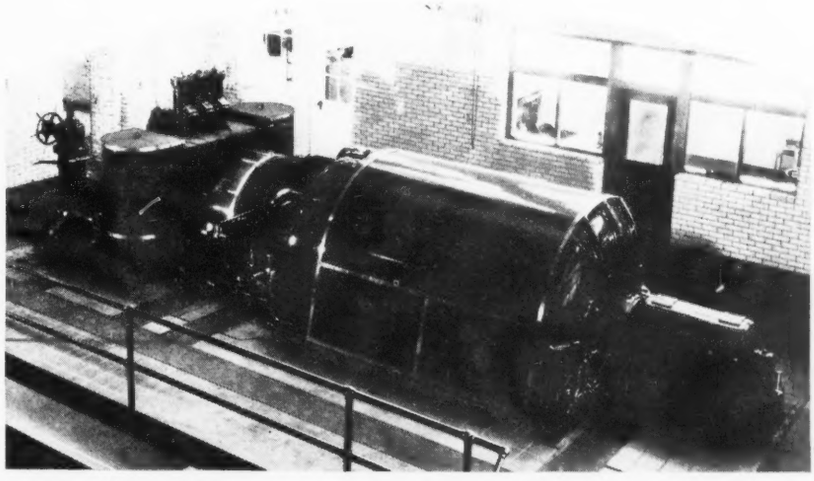
During the year, manufacturers brought out several new boiler designs of a type similar to the integral-furnace boiler first described in 1934. Over 40 boilers of this type have been installed or are on order for capacities up to 170,000 lb. per hr. and pressures up to 700 lb. The new designs employ completely water-cooled furnaces and 2-drum boilers using both large- and small-diameter tubes.

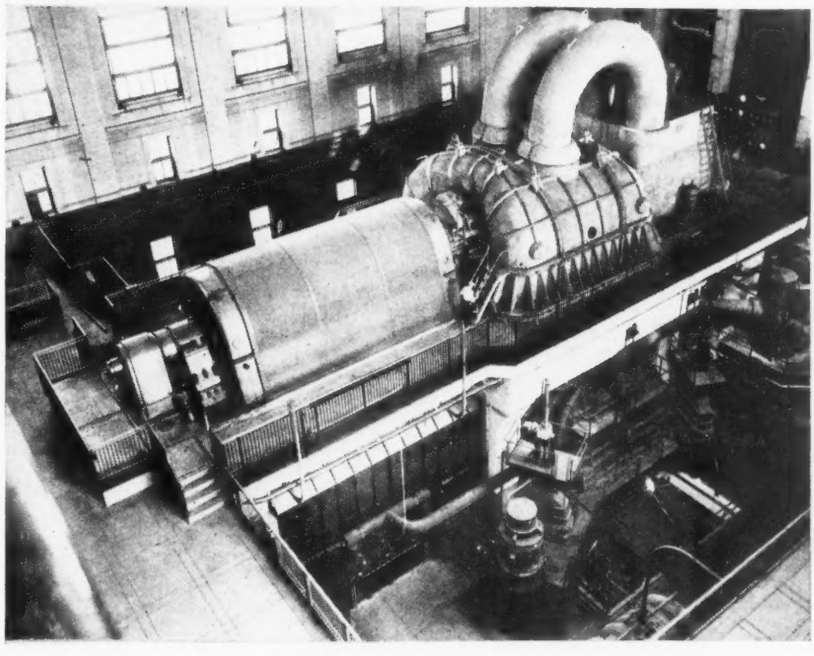
An additional new design has a single steam drum and a mud drum of half length. Two large headers at mud-drum elevation extend the length of the boiler and are connected to the steam drum with tubes which form the furnace between them. It is claimed that 2,500-sq.ft. units can be shipped completely assembled. They are built for pressures up to 450 lb. and in sizes over 5,000 sq.ft. of heating surface.

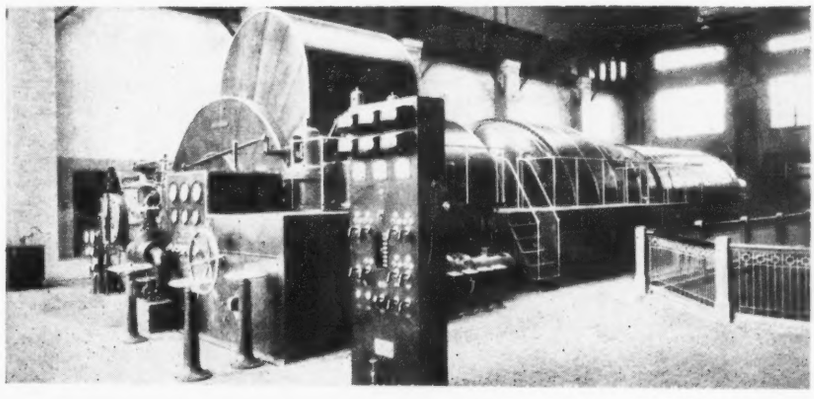
The Port Washington boiler which went into operation last year is the largest 3-drum bent-tube unit of this type, with a capacity of 690,000 lb. of steam per hr. All three drums are 40-in. in diameter $5\frac{1}{4}$-in. thick solid forgings machined inside and out. The boiler is fired with a bin system of pulverized fuel and is provided with a combination radiant and convection superheater. Tubes of the radiant superheater are of special chrome-molybdenum alloy.

Refractory-covered slag-screen tubes of the type used at Buzzard Point station were installed in the new boilers at Richmond, but moved closer to the slag-tap furnace bottom further to shield the furnace from the cooling effect of the boiler tubes, thus making a hotter slagging zone.

Development of a water-cooled underfeed stoker was reported on which it appears possible to burn many low-ash-fusion-temperature coals that heretofore could not be used with this type of firing equipment. In addition it seems possible that this development will permit higher preheated-air temperatures without increasing maintenance costs. The unit has already demonstrated lower power consumption in tests made at the Cedar Rapids Plant of Iowa Electric Light & Power Co. where the development work was carried on.







Top—10,000-kw., 1,400-kw. turbine of Firestone Tire and Rubber Co. Center — Vertical circulating pumps are used with the 165,000-kw. unit at Richmond. Bottom—Tandem compound, 80,000-kw. turbine at Port Washington

STEAM PLANTS PLACED IN OPERATION

	Company	Location	Date First Operation	Pressure, Lb. Per Sq. In.	Temperature, Deg. F.	Boiler: Number	Boiler: Capacity, Lb. Per Hr. Each	Boiler: Heating Surface, Sq. Ft.	Boiler: Water Wall Surface, Sq. Ft.	Economizer: Number	Economizer: Surface, Sq. Ft.	Air Preheater: Number	Air Preheater: Surface, Sq. Ft.	Furnace Vol., Cu. Ft.
Utility	Appalachian Electric Power Co.	Logan, W. Va.	1937	1,250	925	..	.....	.....	.....	..	.....	..	.....	.....
	Milwaukee Electric Railway & Light Co.	Port Washington	Sept., 1935	1,390	840	1	690,000	44,100	7,710	..	.....	2	60,500	58,000
	Rochester Gas & Electric Corp.	Rochester, N. Y.	.....	750	...	1	250,000	15,300	.....	1	20,808	..	.....	.....
	Iowa Electric Light & Power Co.	Cedar Rapids, Ia.	July, 1936	750	765	1	300,000	13,600	2,150	1	4,608	1	16,800	8,100
	Detroit Edison Co., Mich.	Conners Creek	.....	710	850	4	330,000	26,764	3,417	8	8,620	8	28,980	11,000
	S. Ind. Gas & Electric Co.	Evansville, Ind.	.....	475	...	1	.....	11,520	.....	1	8,640	..	.....	.....
	Philadelphia Electric Co.	Richmond	1935	425	850	2	600,000	36,200	4,648	..	.....	2	48,000	26,900
	Central Vermont Railway, Inc.	St. Albans	Nov., 1935	200	448	2	15,515	2,500	....	..	.....	..	.....	.....
	General Public Utility, Inc.	Deadwood, S. D.	.....	...	...	..	.....	.....	....	..	.....	..	.....	.....
	Abington Electric Co.	Clarks Summit, Pa.	.....	...	...	..	.....	.....	....	..	.....	..	.....	.....
	Virginia Public Service Co.	Hampton, Va.	.....	...	...	..	.....	.....	....	..	.....	..	.....	.....
Municipal	City of Fort Collins	Fort Collins, Colo.	1936	425	710	2	25,000	4,000	175	..	.....	..	.....	1,500
	City of McPherson	McPherson, Kan.	July, 1935	400	...	..	.....	.....	....	..	.....	..	.....	.....
	City of Anthony	Anthony, Kan.	Jan., 1935	375	580	..	.....	.....	....	..	.....	..	.....	.....
	South Pittsburgh Water Works	Pittsburgh, Pa.	May, 1935	300	705	1	40,000	3,894	....	..	.....	..	.....	1,549
	Village of Willard	Willard, Ohio	April, 1935	225	510	1	.....	3,200	....	..	.....	..	.....	1,100
	City of East Palestine	Ohio	1935	200	475	1	.....	5,170	....	..	.....	..	.....	.....
	City of Fairmount	Minnesota	Dec., 1935	185	...	..	.....	.....	....	..	.....	..	.....	.....
	City of Worthington	Minnesota	1936	175	500	..	.....	.....	....	..	.....	..	.....	.....
	Borough of Chambersburg	Chambersburg, Pa.	.....	...	...	..	.....	.....	....	..	.....	..	.....	.....
Industrial Plants	Firestone Tire & Rubber Co.	Akron, Ohio	.....	1,400	760	1	300,000	11,793	7,584	1	8,110	1	23,100	14,500
	Ford Motor Co.	Dearborn, Mich.	1936	1,200	900	1	800,000	30,000	7,125	1	26,500	2	86,000	29,000
	Weirton Steel Co.	Weirton, W. Va.	1936	900	815	2	400,000	20,487	4,277	..	.....	2	49,500	17,280
	Pittsburgh Plate Glass Co.	Barberton, Ohio	1936	900	750	1	180,000	15,147	1,803	1	8,240	..	.....	8,830
	Firestone Tire & Rubber Co.	Los Angeles, Calif.	.....	710	700	1	.....	8,430	650	1	11,780	1	14,000	7,350
	Monsanto Chemical Co.	St. Louis, Mo.	.....	675	750	2	65,000	7,562	756	2	1,140	2	3,520	2,560
	U. S. Industrial Alcohol Co.	Baltimore, Md.	May, 1935	625	750	2	125,000	10,070	1,400	..	.....	2	13,500	7,575
	Westinghouse Air Brake Co.	Wilmerding, Pa.	1935	600	700	2	67,500	7,570	442	..	.....	..	.....	.....
	Scott Paper Co.	Chester, Pa.	Oct., 1935	600	735	1	125,000	13,287	....	..	.....	1	8,700	.....
	Container Corp. of America	Phila., Pa.	Jan., 1935	505	635	1	200,000	12,600	4,390	..	.....	1	16,500	9,600
	Ohio Boxboard Co.	Rittman, Ohio	.....	500	610	1	110,000	12,250	1,112	1	5,100	..	.....	4,480
	Richardson Co.	Lockland, Ohio	.....	475	...	1	.....	4,520	....	1	4,608	..	.....	.....
	McWilliams Dredging Co.	Chicago, Ill.	1936	475	750	1	60,000	9,488	....	..	.....	1	7,181	957
	Pioneer Flintkote Co.	Vernon, Calif.	Aug., 1936	450	...	1	50,000	4,490	....	..	.....	..	.....	.....
	Union Bag & Paper Corp.	Savannah, Ga.	Aug., 1935	450	750	3	.....	4,875	....	..	.....	3	2,225	.....
	Congoleum-Nairn Corp.	Kearny, N. J.	Dec., 1935	450	600	1	35,000	4,377	679	..	.....	1	4,150	1,691
	Thermoid Rubber Co.	Trenton, N. J.	.....	450	...	1	300%	4,460	....	..	.....	..	.....	.....
	Tennessee Eastman Corp.	Kingsport, Tenn.	.....	450	...	2	60,000	8,700	....	..	.....	..	.....	.....
	J. K. Mosser Leather Corp.	Williamsport, Pa.	.....	450	...	1	70,000	6,700	290	1	1,895	..	.....	2,349
	John Morrell & Co.	Ottumwa, Iowa	.....	448	...	1	120,000	10,000	2,625	..	.....	1	11,000	8,200
	Owens Illinois Glass Co.	Newark, Ohio	.....	448	750	2	30,000	4,000	1,740	..	.....	2	45,000	2,160
	Homestake Mining Co.	Lead, S. D.	Aug., 1935	448	700	3	65,000	10,000	237	3	2,800	..	.....	4,170
	Rath Packing Co.	Waterloo, Iowa	.....	448	...	1	35,000	5,360	....	..	.....	..	.....	.....
	Titanium Pigment Co.	Sayreville, N. J.	April, 1935	448	637	2	125,000	8,000	5,300	..	.....	2	11,600	6,750
	Celanese Corp. of America	Cumberland, Md.	Dec., 1935	410	710	1	135,000	12,500	3,180	1	5,500	..	.....	5,500
	Shell Corp.	Wood River, Ill.	Aug., 1935	400	455	1	50,000	5,710	Incl.	..	.....	..	.....	1,800
	Phelps Dodge Corp.	Douglas, Ariz.	1936	400	...	1	.....	27,186	....	..	.....	..	.....	.....
	Kroeger Grocery & Baking Co.	Cincinnati, Ohio	.....	400	448	2	55,000	5,280	965	..	.....	..	.....	3,100
	Franklin Board & Paper Co.	Franklin, Ohio	1936	400	600	1	40,000	7,380	....	..	.....	..	.....	.....
	Hershey Chocolate Co.	Hershey, Pa.	.....	400	650	1	150,000	11,650	....	..	.....	..	.....	.....
	Westvaco Chlorine Products Co.	S. Charleston, W. Va.	Aug., 1935	400	665	2	85,000	12,193	1,571	..	.....	4	.....	6,670
	R. J. Reynolds Tobacco Co.	Winston-Salem, N. C.	.....	385	...	..	.....	.....	....	..	.....	..	.....	.....
	Riegel Paper Co.	Milford, N. J.	April, 1935	385	570	1	.....	7,740	300	..	.....	1	.....	7,200
	Wolf River Paper & Fibre Co.	Shawano, Wis.	.....	325	550	1	34,000	4,000	....	..	.....	1	2,000	3,300
	Dresden Paper Co.	Dresden, Ohio	.....	310	500	1	45,000	6,453	70	..	.....	..	.....	1,900
	Hercules Powder Co.	Hattiesburg, Miss.	.....	300	...	2	.....	7,100	....	..	.....	..	.....	.....
	Savannah Sugar Refining Co.	Savannah, Ga.	June, 1935	300	620	1	125,000	8,500	1,440	..	.....	1	10,000	5,600
	American Dyewood Co.	Belleville, N. J.	June, 1935	275	...	1	.....	2,534	....	..	.....	..	.....	.....
	Eastman Kodak Co.	Rochester, N. Y.	.....	260	550	..	.....	.....	....	..	.....	..	.....	.....
	Old Crow Distillery	Frankfort, Ky.	Oct., 1935	250	406	3	33,000	3,990	141	..	.....	..	.....	2,000
	Whippany Paper Board Co.	Whippany, N. J.	.....	250	...	1	66,000	7,500	540	1	3,000	..	.....	4,200
	Carnegie Steel Co.	MacDonald, Ohio	Dec., 1935	250	525	1	40,000	6,154	....	..	.....	..	.....	1,384
	Diamond Match Co.	Oswego, N. Y.	.....	225	547	1	.....	5,005	....	..	.....	..	.....	1,835
	Ford Motor Co.	Chester, Pa.	Sept., 1935	225	500	1	15,000	5,040	....	..	.....	..	.....	1,500
	Clearfield Bituminous Coal Co.	Indiana, Pa.	.....	225	...	1	.....	10,050	550	..	.....	..	.....	.....
	Bogota Paper & Board Co.	Bogota, N. J.	.....	200	...	3	.....	.....	....	..	.....	..	.....	.....
	Hiler, Engr. & Constr. Co.	Providence, R. I.	1936	200	493	2	24,000	6,790	....	..	.....	2	4,000	1,200
	Arnold Print Works	North Adams, Mass.	June, 1935	199	...	1	115,000	8,460	3,535	..	.....	1	10,000	.....
	Cleveland Quarries Co.	So. Amherst, Ohio	Sept., 1935	199	467	1	.....	5,160	....	..	.....	..	.....	.....
	Sonoco Products Co.	Hartsville, S. C.	1935	185	531	..	.....	.....	....	..	.....	..	.....	.....
	Crampton & Knowles Loom Works	Worcester, Mass.	Feb., 1935	180	394	1	40,000	4,800	480	..	.....	..	.....	2,500
	Utica Knitting Co.	Sherburne, N. Y.	Mar., 1935	180	480	1	20,000	3,620	....	..	.....	..	.....	700
	Chickasaw Cooperage Co.	Memphis, Tenn.	Jan., 1935	180	...	1	.....	6,017	....	..	.....	..	.....	.....
	International Harvester Co.	Springfield, Ohio	.....	175	...	1	60,000	5,250	1,568	..	.....	..	.....	.....
	A. Gross & Co.	Newark, N. J.	.....	160	...	2	12,000	3,870	....	..	.....	..	.....	560
	Crystal Tissue Co.	Middletown, Ohio	June, 1935	160	320	1	60,000	6,430	1,100	..	.....	1	6,100	3,700
	U. S. Immigration Station	Baltimore, Md.	Oct., 1935	160	...	3	.....	1,060	....	..	.....	..	.....	.....
	Midvale Steel Co.	Phila, Pa.	Dec., 1935	160	370	1	83,000	10,009	....	..	.....	..	.....	.....
	German Brewery	Cumberland, Md.	Mar., 1935	160	370	2	19,000	5,040	....	..	.....	..	.....	4,000
	Falls City Brewing Co.	Louisville, Ky.	July, 1935	150	420	1	.....	5,600	....	..	.....	..	.....	.....
	Broadmoor Hotel	Colorado Springs, Col.	1935	150	463	1	25,000	4,044	....	..	.....	..	.....	2,358
	American Smelting & Refining Co.	Perth Amboy, N. J.	.....	150	...	..	.....	.....	....	..	.....	..	.....	.....
	Gair Cartons, Inc.	Piermont, N. Y.	.....	150	...	7	.....	3,000	....	..	.....	2	.....	.....
	Charlton Woolen Co.	Charlton, Mass.	Aug., 1935	150	...	1	.....	3,250	....	..	.....	..	.....	.....
	American Crystal Sugar Co.	Chaska, Minn.	Sept., 1935	155	...	3	31,739	8,912	....	..	.....	..	.....	3,625
	American Steel Foundries Co.	Granite City, Ill.	Dec., 1935	150	456	2	43,300	5,676	....	..	.....	..	.....	1,270
	American Water Works	Davenport, Ia.	Dec., 1935	150	...	1	.....	1,800	....	..	.....	..	.....	.....
	Benj. Moore & Co.	Carteret, N. J.	.....	150	...	2	.....	1,500	....	..	.....	..	.....	.....
	Avery Salt Co.	Avery Is., La.	.....	140	...	..	.....	.....	....	..	.....	..	.....	.....
	Peninsular Paper Co.	Ypsilanti, Mich.	Oct., 1935	125	...	1	.....	3,012	....	..	.....	..	.....	.....
	Cudahy Packing Co.	Los Angeles, Calif.	1936	125	353	2	.....	3,411	....	..	.....	..	.....	.....
	Libby, McNeill & Libby	Walla Walla, Wash.	June, 1935	125	353	1	.....	3,113	....	..	.....	..	.....	.....
	Public Service Electric & Gas Co.	Paterson, N. J.	Sept., 1935	125	450	1	35,000	5,030	....	..	.....	..	.....	810
	Pennsylvania R. R.	Newark, N. J.	Jan., 1935	100	338	2	10,350	3,000	....	..	.....	..	.....	1,065
	Evening News Publishing Co.	Newark, N. J.	.....	...	...	..	.....	.....	....	..	.....	..	.....	.....
	American Woolen Co.	Lawrence, Mass.	.....	...	...	..	.....	.....	....	..	.....	..	.....	.....
	Garden City Co.	Garden City, Kan.	.....	...	...	..	.....	.....	....	..	.....	..	.....	.....
Institutions	Ohio State Penitentiary	Columbus, Ohio	Sept., 1935	450	700	1	45,000	5,074	....	..	.....	..	.....	.....
	Anchor Hospital	St. Paul, Minn.	.....	250	...	1	.....	3,681	....	..	.....	1	.....	.....
	University Texas	Austin, Tex.	.....	250	...	1	.....	6,050	....	..	.....	..	.....	.....
	Veterans Administration Home	Hampton, Va.	.....	200	...	2	12,075	3,500	....	..	.....	..	.....	.....
						2	17,250	5,000						
	Alabama Insane Hospital	Tuscaloosa, Ala.	.....	180	379	1	50,000	8,300	....	..	.....	..	.....	.....
	Worcester Polytechnic Inst.	Worcester, Mass.	Oct., 1935	175	...	1	18,000	2,540	....	..	.....	..	.....	656
	Texas Tech. College	Lubbock, Tex.	.....	165	...	1	.....	3,560	....	..	.....	..	.....	.....
	Rome State School	Rome, N. Y.	.....	...	...	2	.....	5,260	....	..	.....	..	.....	.....
	Maryland Tuberculosis Sanitarium	Sanitarium, Md.	.....	150	...	1	.....	2,850	....	..	.....	..	.....	.....
	Newberry State Hospital	Newberry, Mich.	.....	125	...	3	30,000	12,716	....	..	.....	..	.....	.....

C.T.—Condensing Turbine, T.C.T.—Tandem Compound Turbine, V.C.T.—Vertical Compound Turbine, B.P.T.—Back Pressure Turbine, B.B.P.T.—Bleeder

OR UNDER CONSTRUCTION DURING 1935

Method of Firing	Fans: Forced: Number	Fans: Forced: Capacity, c. f. m.	Fans: Induced: Number	Fans: Induced: Capacity, c. f. m.	Boiler Feed Pump: Number	Boiler Feed Pump: Capacity, g. p. m.	Main Generating Units: Number	Main Generating Units: Type	Main Generating Units: Capacity, Kw.	Bleed Points: Number	Bleed Points: Pressure	Cond. Sfce., Sq. Ft.	Circulating Pump: Number	Circulating Pump: Capacity, g. p. m.	Remarks
							1	Turbine	40,000						3,600-R.P.M. Turbine.
Bin. P. C.	2	112,500	2	185,000	3	750	1	T. C. T.	83,000	5		52,500	2	55,000	Reheat Pressure, 422 Lb.
P. C.							1	Turbine	6,000						
Stoker	1	110,000	1	160,000	1	600	1	B. P. T.	5,000						
U. Stoker	4	101,000	4	181,000	6	647	3	C. T.	33,000	4					Two additional 60,000-kw. Units on order.
							1	C. T.	12,500			13,000			
P. C.	2	102,500	2	190,000	3	3,000	1	T. C. T.	165,000	4		113,000	2	155,000	Plant Addition.
Stoker	1	15,000			1	86									
							1		3,000						
							1	C. T.	3,000						
							1	C. T.	7,500						
Stoker	2		2		3	50	1	C. T.	1,000			2,000	2	3,000	
							2	C. T.	1,500			4,600			
Gas			1	20,000			1	B. C. T.	3,000	2	5	5,000	2	2,300	
					2	51.6	1	B. C. T.	750		14.7–40	1,600	1	1,650	Turbine Designed for 643 Lb., 650 Deg.
P. C.					2	160									
O. F. Stoker	1				1										Boiler Feed Pump, 7½x4½x10-in.
O. F. Stoker	1	22,000													
							1	B. C. T.	1,500	1	5	2,000	1	2,500	
							1	B. C. T.	1,250	1	10	2,500	1	3,000	3 New Superheaters.
							1	B. C. T.	2,500	1	35	2,820	1	3,000	
P. C.	1	103,000	1	183,000	2	850	1	B. P. T.	10,000						Exhaust Pressure, 250 Lb.
P. C.	4	79,000	2	282,000	2	2,400	1	B. P. T.	15,000	4		73,000	2	58,700	
							1	V. B. C. T.	110,000						
P. C. & Gas	2	113,000	2	228,000	3	890	1	B. P. T.	10,000						Exhaust Pressure, 215 Lb.
U. Stoker	1	70,000	1	120,000	2	400	1	B. B. P. T.	6,000	1	400				
Oil & Gas	1	40,400	1	102,500			1	B. B. P. T.	5,500	1	235				Exhaust Pressure, 150 Lb.
C. G. Stoker	2	32,000	2	56,000	2	360	2	B. B. P. T.	5,000	1	350				
P. C.	2	50,000	2	87,500	2	650	2	B. P. T.	2,000						Exhaust Pressure, 100 Lb.
U. Stoker	2	56,000			2	850	1	B. P. T.	1,500						
Oil	1	40,000	1	100,000	2	350	1	B. T.	3,500	1	275				
P. C.	1	50,000	1	250,000	2	425	1	B. C. T.	6,000	2	40–170	2,400	1	3,000	
C. G. Stoker	1	55,000	1	110,000	1	300									
Oil			1	30,600	1	125	1	C. T.	3,500			4,150	1	10,000	
							1		750						
Oil & Gas															
	3	49,300	3	64,600			1	B. C. T.	7,500	2	30–125	3,600			
P. C. or Oil	1	10,800	1	18,800											
C. G. Stoker	1	19,000			1	150									
U. Stoker	1	30,000			1	450	1	C. T.	3,000	1	90	4,100			
C. G. Stoker	2	32,000	2	30,000	2	300	1	B. P. T. (Future)	1,000						
P. C.	2	40,000	1	68,000											
P. C.	2	11,350	2	19,900	2	100	1	B. P. T.	500						
							2		1,875			1-9,500	1	11,900	
Sp. Stoker	3	44,000	3	61,000	3	240	2	B. C. T.	5,000	1		1-8,000	1	10,000	
												2-2,500	2	3,000	
C. G. Stoker	1	20,000			2	160	1	B. P. T.	625	1	125				
P. C. & Oil	2	35,000	2	47,800	2	544	2	B. C. T.	3,000	2	30–125	1,700	2	2,500	
U. Stoker	1	48,000	1	95,000	1	500									
Oil & Gas			1	21,600	2	130									
Waste Heat															
P. C.	2	14,000	2	89,000	2	160	2	Future	1,000						
C. G. Stoker	1				2	125	1	B. C. T.	1,500	3	15–50–150	750	1	800	
P. C.							1		10,000	2	7–175				
P. C.							2	B. C. T., B. P. T.	15,000	1	15	8,500			
U. Stoker							1	B. P. T.	7,500	1	150				
P. C.															
P. C.	1				2	100	1	B. P. T.	500						Exhaust Pressure, 100 Lb.
U. Stoker	1	20,000			2	150	1	Turbine Drives	370						
R. Grate					2	290									
Oil	1	34,000	1	63,000	2	264									
U. Stoker															
							1	B. B. P. T.	2,000	1					Exhaust Pressure, 70 Lb.
U. Stoker	3	13,000			2	120									
P. C.	1		1												
C. G. Stoker	1	22,000													
U. Stoker	1	17,500													
Oil															
Stoker	1	30,000													
							1		1,500						
C. G. Stoker	2				2	200	1		1,250						
Waste Gas	2	15,000	2	35,000	2	100	2	C. T.	1,250			1,550	2	2,350	
P. C.	1	30,400	1	52,000											
Stoker	1	15,000													
							1	B. P. T.	1,000						Exhaust Pressure, 30 Lb.
P. C.	1	10,000													
Hand	1				3	120	2	C. T.	1,050			1,100	2	2,450	
							1	Engine	500						
U. Stoker	1	32,000	1	40,000	2	200									
U. Stoker															
P. C.	1	17,700	1	28,800	2	450	3	C. T.	1,600				2	1,400	
Oil					2	30									
P. C. or Oil	1	25,400													
U. Stoker	2	8,500			1	100									
C. G. Stoker	1	2,000					1	Engine	500					1,200	
Oil & Gas															
							1	C. T.	1,250			1,450	1	2,100	Future Pressure, 400 Lb.
C. G. Stoker	3		2		2	500	1	B. C. T.	2,000	1	10				
U. Stoker	1		1		1										
Stoker	1	65,000			3	300									
C. G. Stoker	2	17,900													
U. Stoker															
Oil															
							1	B. P. T.	750						Exhaust Pressure, 5 Lb.
U. Stoker					2										
Gas					2										
U. Stoker	1	8,000			2	112									
Hand	1	18,500													
Stoker	1	20,000			2	150									
							1	C. T.	1,000			2,000	1	2,300	
							1		5,000	2	100–10		1	4,950	
									500	1	10		1	500	
							1	B. T.	2,000	1	150	4,800			
U. Stoker	1		1												
P. C.							3	Engine	450						
Stoker	2	11,200			2	360									
	2	16,000													
Stoker	1	12,000													
U. Stoker	1														
Gas & Oil															
U. Stoker	2	50,000			2	180									
U. Stoker							2	Engines	125						
U. Stoker							4	Engines	420						

Back-Press. Turbine, B.C.T.—Bleeder Condensing Turbine.

A new pulverizer feeder adjusts coal feed to conform with the air flow through the pulverizer. It is claimed this simplifies the application of automatic controls and results in a wider range in capacity.

A new pulverizer with a revolving bowl was announced during the year. Coal is ground between a grinding ring and stationary reduction rolls and works up the walls of the bowl, where fines and intermediate sizes are picked up by air currents from annular spaces around the bowl. Clearance between rolls and revolving bowl and grinding pressure may be adjusted from outside while the mill is running.

The new 110,000-kw., 1,200-lb., steeple-compound Ford turbine has not gone into operation. The high-pressure element of this unit, mounted above the low-pressure, drives a separately excited 55,000-kw. generator and has twelve stages. The double-flow low-pressure cylinder has ten stages on each side of the central steam admission. The high-pressure cylinder exhausts without reheat directly into the low-pressure element at 86 lb. abs. at full load. The 900-deg. initial temperature makes reheat unnecessary.

In contrast, the 1,230-lb., 825-deg. Port Washington turbine is arranged for reheating. Pressure at the reheat point is approximately 422 lb. abs. at full load. Admission of reheat steam is to the center of the high-pressure cylinder, which exhausts at about atmospheric pressure to the low-pressure element.

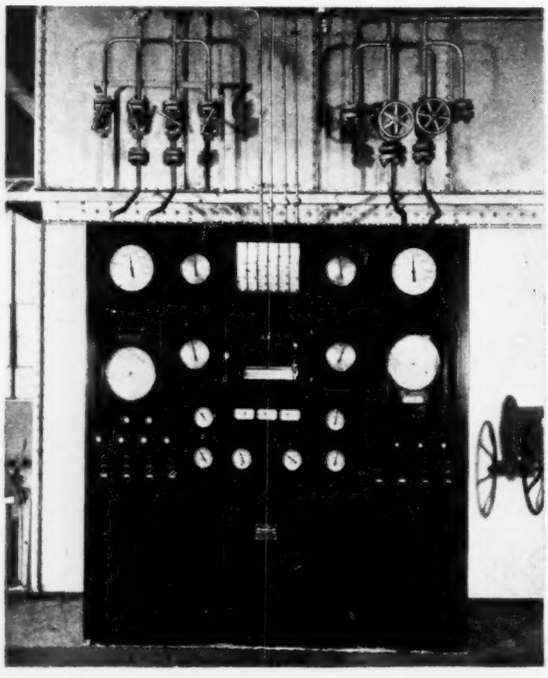
The 165,000-kw. Richmond Station turbine has a higher kilowatt rating than any other tandem-compound unit. It has 30 rows of blades in the high-pressure rotor, and each side of the double-flow, low-pressure end has 8 rows of blades. Low-pressure blades shown in the illustration are 38 in. long, have a tip speed of 72,600 ft. per min., and are faced with Stellite.

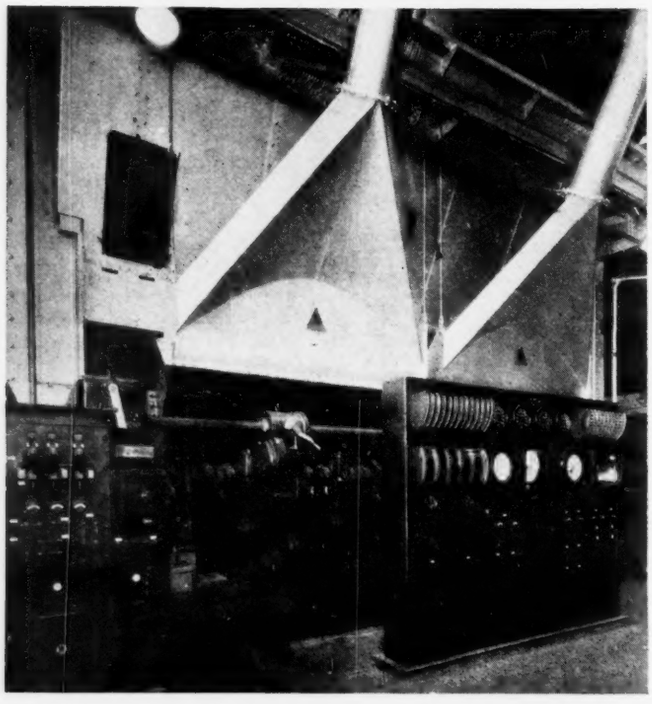
Turbine speed is controlled by a hydraulic governor which operates through a pressure transformer to control the flow of Aroclor to the operating cylinders of the seven control valves.

This unit exhausts to the largest condenser in a single shell. It is single-pass, with 113,000 sq.ft. of cooling surface provided by 17,700 tubes. The tubes are arranged radially around a central air off-take, and with due regard to pressure distribution at the turbine exhaust flange which distribution was determined by research on models of the unit. The shell is of fusion-welded steel plate. Cooling water is supplied by two vertical propeller-type pumps with a combined capacity of 155,000 g.p.m.

Several new small turbine units were brought out during the year, but on the larger machines no important changes in design have been reported. This latter observation is also true of steam engines, and no large engine installations have been reported.

Control board for the 1,400-lb. boiler in the Firestone plant. Bottom—One of the new zoned automatic air-controlled stokers at Connors Creek station of Detroit Edison Co.





Power Maps

FEDERAL POWER COMMISSION will soon issue two maps compiled by its National Power Survey, showing service areas, generating plants and transmission lines of the principal U. S. utility systems. Both are in full colors, one 51½ by 81 in. and the other 57½ by 84 in.

Map No. 1, "Service Areas of the Principal Electric Utility Systems in the U. S., 1935," identifies 57 major utility systems, 8 municipal systems, and 50 holding companies and independent operating companies.

Map No. 2, "Principal Generating Plants and Electric Transmission Lines of the U. S., 1935," indicates 345 hydro-electric plants, 709 fuel generating plants and transmission lines totaling 135,000 circuit miles.

Maps will be sold by the Federal Power Commission, Washington, D. C., as follows:—Map No. 1, unmounted, in two sections, $7.50; mounted on linen with reinforcing rails, $10. Map No. 2, unmounted, in two sections, $5; on linen with reinforcing rails, $7.50.

NEW ELECTRICAL MILESTONES Established in 1935

Public utilities generated 99-billion kw.-hr., an all-time peak; record hydrogen-cooled generators, frequency changers and synchronous condensers

AN INCREASE of around 9 billion kw.-hr. generated by public-utility plants ranks as an outstanding achievement in the electrical industry for 1935. This increase is exceeded only by that for 1929, when 9.5 billion kw.-hr. more were generated than in 1928. Beginning with the first of June, the 1935 weekly kilowatt-hour curve crossed that for 1929, and has steadily remained above it, reaching an all-time peak in excess of 2 billion kw.-hr. for the week, Dec. 15-21. A total generation of around 99 billion kw.-hr. was reached, compared with 97.4 billion in 1929, and a maximum weekly peak of 1.86 billion.

As would be expected, this large increase in power generation presaged renewed industrial activity, with placing of orders for all kinds of power equipment to build new plants and to modernize and enlarge old ones. A large part of the activity in power-equipment installation has been in manufacturing and processing plants. Near the end of the year, central-station projects began to pick up, but when these companies will begin to build on a pre-depression scale depends on several factors difficult to evaluate.

Record Turbine-Generator

Few new units are on order for central-station steam plants. Outstanding among these is a 40,000-kw., 3,600-r.p.m. unit for the Logan station, American Gas & Electric Co. This generator will have more than double the capacity of the now largest 3,600-r.p.m. generator, rated at 18,000 kw., in this country. Hydrogen cooling will be a feature of this generator. This system of cooling has been used on several large synchronous condensers, and frequency changers, but has been applied to only a few generators. Two new 60,000-kw. units are also on order for Detroit Edison.

One trend seems to be toward reconstructing old turbine-generators for higher ratings. For example, New York Edison Co. is having rebuilt a 30,000-kw., 1,500-r.p.m., 25-cycle turbine-generator for operation at 1,800 r.p.m. and 40,000 kw., 60 cycles. The work being done by the Detroit Edison Co. in rebuilding Connors Creek Station may be cited as another example.

One important steam-turbine generator put into operation was the 165,000-kw., 0.90-p.f., 1,800-r.p.m. unit in the Richmond Station, Philadelphia Electric Co., and another is the 80,000-kw. machine installed in Port Washington station of Milwaukee Electric Railway & Light Co. The former is installed in space provided for a 60,000-kw. unit. Because of space restrictions, unusual mechanical and electrical problems were encountered. One of these was ventilation of the generator, which requires a total of 170,000 cu.ft. of air per min. This is done by specially developed air-foil propeller fans, motor-driven at 3,550 r.p.m.

In the hydro-electric field, most construction activities are Federal government or other public projects, financed in whole or in part from Washington. None of these projects has yet come into operation, but several will this year. Outstanding is Boulder Dam. The six large generators ordered for this plant are rated at 82,500 kva., 16,500 volts, 180 r.p.m. They stand 32 ft. above floor level, and are 40 ft. in diameter. A rotor load of nearly 1.75 million lb. is taken by a single thrust bearing above the generator.

Features of the two 56,000-kva., 13,800-volt, 112-r.p.m., umbrella-type generators for Norris Dam, TVA project, are their telescopic exciters. Approximately 3.5 ft. reduction in overhead room results from using this exciter design. The main exciter armature is mounted on a specially designed spider bolted to the top of the main generator rotor, and the upper bracket supports its field frame. The pilot exciter armature is located inside the main exciter armature, with its stationary member supported on the main bracket.

Other large hydro-electric generators on order are the two 36,000-kva. for Joe Wheeler project, TVA, and the two 54,000-kva. units for Bonneville on the Columbia River. Because of their slow speed, 86 and 75 r.p.m., respectively, they have very large dimensions.

Automatic Hydro Plants

Automatic hydro plants are again receiving attention. A plant having one 10,000-hp. unit is being installed by Idaho Power Co., to be controlled from a station three miles away. Control and metering will be accomplished over a 12-conductor cable. It is planned to operate the London and Marmet plants of Kanawaha Valley Power Co., W. Va., from the Cabin-Creek steam plant about 10 mi. from each plant. These hydro plants will each have three units, two propeller and one Kaplan wheel, totaling 20,850 hp.

Two of the largest hydrogen-cooled synchronous condensers so far constructed will be installed at the receiving end of the 287,000-volt line from Boulder Dam to Los Angeles. They are each rated 60,000 kva., 13,800 volts, and have a lagging capacity of 36,000 kva. These machines will be automatically started and put on the line upon indication from the main control unit.

DIESELS SPEED UP

New materials, refined designs, permit higher-speed units. Sales reach a million and a quarter horsepower. Gas engines gain steadily

By E. J. Tangerman
Associate Editor

DIESELS continued their spectacular advance in 1935, sales for the year totalling in the neighborhood of 1,250,000 hp., a goodly proportion of the 66% increase over 1934 being represented by tractor and construction units, although stationary and motive-power applications also gained in lesser degree. Better materials and more businesslike approach to design problems resulted in increased speeds (with consequent reduced weight or higher power), better appearance and improved operation. Gas engines likewise showed an advance, several companies entering this field which previously had not built these engines, one or two companies redesigning certain diesels for conversion to gas engines, and other companies modernizing designs.

There is also steadily increasing understanding of the possibilities of waste-heat utilization and sound and vibration isolation, and more practical use of the diesel in combination with steam. A notable installation of the year of this type is the 525-hp. diesel installed in the Singer Building last June, which now is reported to be paying for itself at a rate of $2,000 a month. If maintained, this saving will pay for the installation in about 2½ or 3 years. This installation is also notable in the unusual coil-spring mounting which supports engine and generator weight, a total of 84 tons. Other unusual elements here are the indoor cooling tower beside the engine in the basement and the careful utilization of waste heat, the latter element alone being estimated to save $1,600 per year.

Maintenance of frequency has also received attention during the year. The Singer installation, as well as many others, have installed isochronous or other close-governing systems to maintain frequency within very close limits despite heavy load swings.

Most engines introduced during the year were refinements of earlier designs, principal improvements being in increased speeds, more attention to details, and improved exterior appearance. There is a steadily increasing trend towards use of auxiliaries, particularly in larger engines, all for better operation and lower maintenance over the long period. About 40% of engines installed use air filters, 10% use air washers, 60% use lubricating-oil filters or centrifuges, more than 50% use pyrometers. Builders urge greater use.

The horizontal, crankless diesel introduced last year has been improved for direct connection to a 50-kw. generator to run at 1,200 r.p.m. One radical design of the year was a radial engine modeled after airplane practice but designed for railcar and stationary use. Weighing only 6 lb. per hp. with auxiliaries, the first 6½x7½-in., 2-cycle, 635-hp. unit runs at 1,400 r.p.m., is only 71 in. in diameter, and has a fuel economy only slightly poorer than standard designs. One manufacturer of small engines will soon announce an 8-cyl., V-type, 180-hp. unit. To compete with gasoline, very small solid-injection units are being developed very rapidly. One company is making a 2-cyl., 20-hp., unit to sell for $60 or less per hp. An engine built for 12.5 hp. per cylinder at 720 r.p.m. can be brought from cold to full load in 8 sec. One interesting 50-hp. engine is converted to a gasoline engine for starting by hand cranking, then switches to diesel after 700 revolutions.

Of extreme importance are the new high-speed power units offered by a number of manufacturers, some of them simply tractor engines mounted on structural-steel bases. These units have radiator, fuel-pump system, fuel filter, fuel-oil pressure gage, air cleaner, starting equipment, lubricating-oil filter, tank, pump and pressure gage, temperature indicator and other instruments, plus other auxiliaries mounted on them, and often have clutch, extension shaft and belt pulley. Outboard bearings are furnished with larger units, direct-connected a.c. or d.c. generators can be obtained, and yet over-all dimensions are unusually small.

Fuel Systems

One diesel announced this year has a combined fuel pump and injector, eliminating long runs of high-pressure piping and giving positive metering. Another injection system has all parts replaceable. Solid injection has almost completely replaced air injection, except for lower-grade fuels and other special conditions, avoiding complicated injection equipment and reducing operating difficulties. The 2-cycle versus 4-cycle debate still goes on merrily. 2-cycle units are steadily being stepped up in rotative speed. While municipal and larger industrial installations are usually low-speed types, greatest activity has been in high-speed types above 800 r.p.m.

The fuel problem is an increasingly important one, particularly with steadily rising rotative speeds. Continuous research and comparison of results during the past year, however, begin to point toward an ultimate solution agreeable to all three interested parties, engine builder, oil supplier and operator.

Engine details improved during the year include anti-friction bearings, more effective lubrication, greater adoption of supercharging, higher volumetric efficiency, more durable cylinder liners and pistons, and piston rings which seal without destroying liners. Heat-treated nickel cast irons are being used increasingly for liners, crankshafts, heads and other parts. Aluminum pistons have been improved by casting in an aluminum-bronze ring belt into which piston-ring grooves are machined.

Development of new engines by several manufacturers has drawn heavily upon automotive and air-craft experience. Material and heat-treatment specifications of such parts as crankshafts and camshafts, camshaft driving gears, connecting rods, cylinder liners, pistons, cylinder heads, valves and springs have received very careful consideration and inspection has been tightened down to extremely narrow limits.

It was reported during the year that engines planned for use in the southwestern oil fields must be designed to run on sour crudes because of the frequent application of these engines in out-of-the-way places where refined fuel is not available. The trend in pumping fields is steadily toward smaller engines, mostly 1-cyl. horizontals, although the multi-cylinder, fairly high-speed verticals are coming in, driving through reduction gearing. Normally, such engines should be used with cooling towers and should be started and stopped with regular diesel fuel. Diesel-electric drilling rigs using d.c. motored setups are also finding favor in the fields, using the Ward-Leonard system.

Foreign Developments

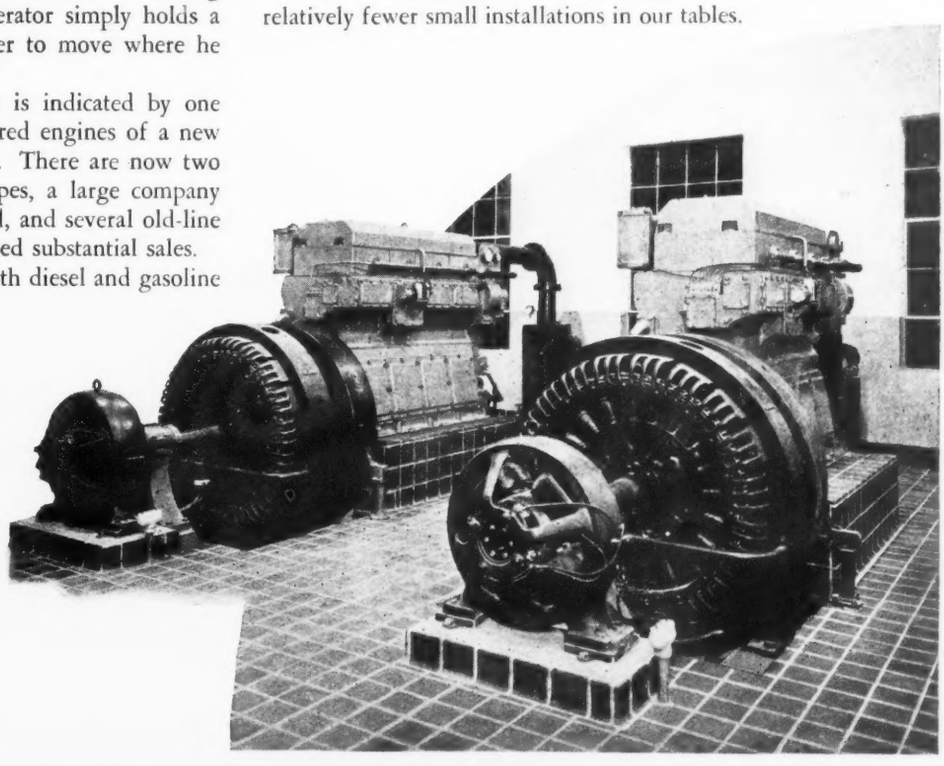
One very interesting foreign installation of the year is that at Clairvivre, France, a government-built garden city for tuberculosis patients, which has seven 635-kw. diesels with peak output of 4,900 kw. Not only all power is provided by this plant, but also all heat for municipal buildings, plus electric heat for residences, made possible because of total utilization of 63% of the heat value of the fuel. Engine thermal efficiency is 34%, and the heat-recovery installation provides the other 29%. On coldest days, load for the 180 houses totals 1,500 kw., total winter electrical load running to 60,000 kw.-hr. per day. Fuel requirements are only 0.51 lb. per kw.-hr.

An interesting foreign construction use of an internal-combustion engine is in the so-called "frog rammer," a heavy half-ton rammer with the engine inside. It derives its name from the fact that the engine expands the rammer, then suddenly contracts it, causing it to jump like a frog. The operator simply holds a handle and can cause the rammer to move where he wills by steering it as it jumps.

Increasing use of gas engines is indicated by one company's sales of about a hundred engines of a new design introduced early this year. There are now two or three convertible-gas-diesel types, a large company is planning entrance into the field, and several old-line gas-engine companies have reported substantial sales.

One West-Coast operator of both diesel and gasoline trucks ran a fairly complete test on ten heavy truck-trailer units of each type. His results showed diesel repair and maintenance costs 25% higher (including addition of some new-design parts during the year), higher costs on the diesel for lubricating oil and other cost elements, but fuel cost only one-sixth as much, giving an advantage to the diesel trucks of two-thirds the gasoline-engine total costs. Among other elements, the diesels ran 60 to 65% further on a gallon of fuel. Trucks are now also running on a mixture of butane and propane, utilizing a modified gasoline engine.

Total sales figures for the year are not available, any figure quoted being merely an expanded estimate. However, based on Diesel Engine Manufacturers' Association of 225,000 b.hp. for the year for its sixteen members, supplemented by reports of many independent manufacturers, diesel sales for 1935 can be placed at about 1,250,000 hp., or 66% more than in 1934. One manufacturer alone sold more than 5,000 engines averaging around 80 hp. each, a total of 400,000 hp., largely for tractor, road patrol and associated uses. A manufacturer of small engines made 55 installations totalling just under 1,000 hp., most of them in plants not previously having diesels. An analysis by *Power* during the year of our recent diesel installation tables showed that about 95% of the diesels sold went into plants not previously using them. The Prime Mover's Committee, Edison Electric Institute, analyzing our 1935 table, found this classification according to use: General industry 89 engines totalling 16,111 hp., or 18.1%; municipal 77 engines totalling 37,732 hp. or 48.6%; refrigeration 32 engines totalling 4,347 hp. or 5.4%; mines and quarries 13 engines totalling 3,583 b.hp. or 4.4%; irrigation 10 engines totalling 6,255 hp. or 7.6%; public utility 4 engines totalling 2,125 hp. or 2.6%, other fields 28 engines totalling 10,729 hp. or 13.3%, a grand total of 253 engines totalling 80,852 hp. 73% of the units listed were low speed, below 400 r.p.m., 23.6% medium-speed to 800 r.p.m., and 3.3% high speed. These proportions would not hold if all installations were listed, but are due to the relatively fewer small installations in our tables.



Two 4-cyl., 150-hp. @360-r.p.m. gas engines driving 100-kw. alternators with direct-connected exciters in the sewage-disposal plant of Durham, N. C.

Hydro-Electric Projects (Equipment Built or on

Company	Designing Engineers	Project Name	[2]New or Redevelop	River	State	Project Started	[3]Dam Type	Crest Length, Feet	Max. Height, Feet	Initial Operation	Initial Cap., Horsepower
New England States											
City of Norwich, Conn.	Chandler & Palmer	Occum		Shebucket	Conn.	1934	.....	.....	...	1935	.....
Great Northern Paper Co.		North Twin	New	.....	Me.	1933	.....	.....	...	1935	.....
Wyoming Valley Paper Co.			.....	.....	N. H.	1934	.....	.....	...	1935	.....
Woodsville Fire Dist.			.....	.....	N. H.	1934	.....	.....	...	1935	.....
Chemical Paper Co.	Ralph L. Bosworth		.....	Conn.	Mass.	1935	.....	.....	...	1935	.....
Town of Littleton	Howard M. Turner	Apthrop	Added	Ammonoosuc	N. H.	....	Crib.	.....	...	1936	.....
E. W. Bailey & Co.			.....	.....	Vt.	1934	.....	.....	...	1935	.....
Lamprey River Improvement Co.		Lamprey	.....	Lamprey	N. H.	1935	.....	.....	...	1936	.....
Middle Atlantic States											
Corps of Engineers U. S. Army	U. S. Engineers	Montgomery Is.	New	Chio	Pa.	1932	V. L. M. G.	1,379	16	1935	.....
East North Central States											
Sanitary District of Chicago	Sanitary District Eng.	Lockport	Redev.	Sanitary Canal	Ill.	1934	.....	.....	...	1935	.....
Ford Motor Co.	Ford Motor Co., Pr. & Const. Dept.	Dundee	Redev.	Raisin	Mich.	1935	C. G.	330	12	1936	192
City of Allegan, Mich.			.....	.....	Mich.	1935	.....	.....	...	1936	.....
City of Lansing, Mich.			.....	.....	Mich.	1935	.....	.....	...	1935	.....
West North Central States											
Loup River Public Pr. Dist.	Harza Engineering Co.	Monroe	New	Loup	Neb.	1934	P. & G.	840	14	1937	9,600
Loup River Public Pr. Dist.	Harza Engineering Co.	Columbus	New	Loup	Neb.	1934	P. & G.	840	14	1937	54,000
Platte Valley Pub. Pr. & Irr. Dist.	Platte Val. Pub. Pr. & Irr. Dist.	Sutherland	New	No. Platte	Neb.	1934	R. E. F.	18,750	67	1936	36,000
Southern Nebraska Pr. Co.			.....	.....	Neb.	1935	.....	.....	...	1936	.....
Interstate Power Co.		Cornell	.....	.....	Iowa	1935	.....	.....	...	1936	.....
South Atlantic States											
New Kanawha Pr. Co.		Hawks Nest	New	New	W. Va.	1930	.....	.....	...	1936	140,000
Kanawha Valley Power Co.	Kanawha Valley Pr. Co.	London	New	Kanawha	W. Va.	1934	U. S. N.	.....	...	1936	20,850
Kanawha Valley Power Co.	Kanawha Valley Pr. Co.	Marmet	New	Kanawha	W. Va.	1934	U. S. N.	.....	...	1936	20,850
Riverside & Dan River Cotton Mills			.....	.....	Va.	1934	.....	.....	...	1935	.....
Republic Service Corp.			.....	.....	Va.	1935	.....	.....	...	1935	.....
Rocky Mount Mills			New	.....	N. C.	1935	.....	.....	...	1936	.....
East South Atlantic States											
U. S. Tenn. Valley Authority	U. S. Bureau of Reclam.	Norris Dam	New	Clinch	Tenn.	1933	C. G.	1,872	266	1936	132,000
U. S. Tenn. Valley Authority	U. S. Bureau of Reclam.	Wheeler Dam	New	Tennessee	Ala.	1933	C. G.	6,335	68	1936	45,000
West South Central States											
Central Texas Hydro-Elec. Co.		Hamilton	New	Colorado	Tex.	1931	M. A.	8,377	154	....	30,000
Mountain States											
U. S. Bureau of Reclamation	U. S. Bureau of Reclam.	Boulder Dam	New	Colorado	Ariz. & Neb.	1931	G. A.	1,180	730	1936	515,000
U. S. Bureau of Reclamation	U. S. Bureau of Reclam.	Boulder Dam	New	Colorado	.....	....	G. A.	1,180	730	....	.....
U. S. Bureau of Reclamation	U. S. Bureau of Reclam.	Casper Alcova	New	N. Platte	Wyo.	1935	C. A.	540	260	1939	42,000
Southern Utah Power Co.	Loeb & Shaw Inc.	No. 4	Redev.	Virgin	Utah	1935	.....	100	5	1935	1,570
City of Idaho Falls		Lower Dam	New	.....	Idaho	1935	.....	.....	...	1936	.....
Idaho Power Co.		Lower Salmon	.....	.....	Idaho	1935	.....	.....	...	1935	.....
Idaho Power Co.		Twin Falls	.....	.....	Idaho	1934	.....	.....	...	1935	.....
U. S. National Park Service		Yellowstone	New	Yellowstone	Wyo.	1935	.....	.....	...	1935	.....
Telluride Power Co.		Upper Beaver	.....	.....	Utah	....	.....	.....	...	1935	.....
Pacific Coast States											
City of Seattle	Lighting & Eng. Depts.	Diablo	New	Skagit	Wash.	1927	C. A. A.	1,260	389	1936	166,000
U. S. Government	U. S. Engineer Corps	Bonneville	New	Columbia	Wash. & Ore.	1933	C. G.	900	170	1937 S.-S. U.	137,000
A. F. C. Jarvie			New	.....	Calif.	1935	.....	.....	...	1936	.....
Southern Calif. Edison Co.	Southern Calif. Edison Co.	Mill Creek, No. 1	Redev.	.....	Calif.	1933	.....	.....	...	1935	.....
Methow River Valley Lt. & P. Co.		Methow R.	New	.....	Wash.	1935	.....	.....	...	1936	.....
City of Milton			New	.....	Ore.	1935	.....	.....	...	1936	.....
U. S. Possessions											
U. S. Panama Canal	U. S. Bureau of Reclam.	Madden Dam	New	Madden	Panama	1931	C. G.	950	220	1935	22,400
Anchorage Lt. & Pr. Co.			.....	Ukluta	Alaska	1934	.....	.....	...	1929	1,500
Maui Agricultural Co.			.....	.....	Hawaii Is.	1935	.....	.....	...	1935	.....
Canada											228,000
Beauharnois Lt., Ht. & Pr. Co.	W. S. Lee, T. H. Hogg and F. B. Brown	Beauharnois	New	St. Lawrence	**Province** Que.	1929	P. & G.	4,500	31	1932	S.-S. U. 334,000 440,000
Ontario Hydro-Elec. Pr. Comm.	Ont. Hydro Elec. Pr. Comm.	Rat Rapids	New	Albany	Ont.	1934	Crib.	.....	...	1935	1,200
Minas Basin Pulp & Pr. Co. Ltd.	Power Corp. of Can. Ltd.	St. Croix	New	St. Croix	N. S.	1933	C. G.	275	47	1935	4,200
City of Ottawa		Queen St.	New	.....	Ont.	1934	.....	.....	...	1935	.....
Altmonte Public Utilities Comm.			New	.....	Ont.	1934	.....	.....	...	1935	.....
Orillia Water Lt. & Pr. Comm.	L. G. McNeice	Workman's Falls	New	Gull	Ont.	1934	C. G.	200	68	1935	5,200
Quesnel Lt. & Water Co. Ltd.	A. F. Peers & A. C. R. Yuill	Baker Creek	New	Baker	B. C.	1935	R. F. C.	135	22	1936	160
The Yukon Consol. Gold Corp. Ltd.	R. E. Franklin	Klondyke	New	Klondyke	Yukon	1933	.....	.....	...	....	10,000
Nova Scotia Power Comm.	Nova Scotia Pr. Comm.	Ruth Falls	.....	East	N. S.	1935	.....	.....	...	....	6,290
Canada Paper Co., Ltd.		Windsor Mills	.....	.....	Que.	....	.....	.....	...	....	.....
Churchill River Power Co. Ltd.		Island Falls	.....	.....	Sask.	....	.....	.....	...	....	.....
James MacLaren Co.		High Falls	.....	.....	Que.	1934	.....	.....	...	....	.....
Hydro-Electric Comm. Ont.		Chats Falls	.....	.....	Ont.	1934	.....	.....	...	.....	.....
Foreign Countries					**Country**						
Bulolo Gold Dredging Co., New Guinea		Baiune	New	.....	New Guinea	....	.....	.....	...	1935	.....
Asnazu Gold Dredging Co., Colombia, S.A.			New	Cauca	Colombia	....	.....	.....	...	1935	.....
Oriental Consol. Mining Co., Chosen		Chorrie	.....	Anju	Chosen	....	.....	.....	...	1935	.....
Rudin & Company, Costa Rica, C.A.		Mirimor	New	.....	Costa Rica	....	.....	.....	...	1935	.....
Baden Copper Co., Chile, S. A.		Pangal	.....	.....	Chile	....	.....	.....	...	1935	.....
W. R. Grace Co., Chile, S. A.			.....	.....	Chile	....	.....	.....	...	1935	.....
Caramanta Mining Co., Colombia, S. A.			New	.....	Colombia	....	.....	.....	...	1935	.....
Cerro de Pasco Copper Co., Peru, S. A.		Mantavo	New	.....	Peru	....	.....	.....	...	1935	.....
Hydro Electrica Espaniola, Millares, Spain			New	.....	Spain	1934	.....	.....	...	1935	.....

[1]A. C. —Allis-Chalmers Mfg. Co.
M. S. —S. Morgan Smith Co.
J. L. —James Leffel & Co.
P. W. —Pelton Water Wheel Co.
I. P. M. —Baldwin Southwark Corp. I. P. Morris Div.
N. N. —Newport News Shipbuilding & Dry Dock Co.
R. H. —Rodney Hunt Machine Co.
W. —Woodward Governor Co.
L. —Lombard Governor Co.
D. E. W. —Dominion Engineering Works, Ltd.
C. A. C. —Canadian Allis-Chalmers Co.
M. S. I. —S. Morgan Smith-Inglis Co.
J. M. C. —Jenckes Mfg. Co.
G. E. —General Electric Co.
W. E. —Westinghouse Elec. & Mfg. Co.
E. M. —Electric Machinery Mfg. Co.
F. M. —Fairbanks Morse Co.
I. E. —Ideal Electric & Mfg. Co.
C. W. E. —Canadian Westinghouse Co.
C. G. E. —Canadian General Electric Co.
A. C. O. —Ateliers de Const. Oerlikon
S. G. E. —Swedish General Electric Co.
E. E. C. —English Electric Co.
M. P. —Mather & Platt, Ltd.

Order) in United States and Canada in 1935

Added Cap., No. of Units	Date of Added Cap.	Ultimate Cap., Horsepower	No. of Units Installed	Water-wheel Capacity, Horsepower	Water-wheel Type	Speed R.p.m.	Static Head, Ft.	Design Head, Ft.	[1]Water-wheel Manuf.	[2]Governor Manuf.	Draft-Tube, Type	Scroll Case, Type	Penstock Valves, Type	Generator Capacity, Kva.	[3]Thrust-Bearing Location	Power Factor	Kilovolts	Cycles	[4]Generator Manuf.
..	....	.....	1	1,265	Kaplan	112.5	13	13	M. S.	W.	.....	Vac. Flume	.....	1,000	B. G.	0.80	4.6	60	E. M.
..	....	.....	1	3,250	Kaplan	171.5	28	28	I. P. M.	W.	.....	.....	.....	3,750	A. G.	0.80	2.4	40	G. E.
..	....	.....	2	3,050	Prop.	171.5	28	28	I. P. M.	W.	.....	.....	.....	3,250	A. G.	0.80	2.4	40	G. E.
..	....	.....	1	.....	.....	100	...	....	.....	.....	.....	.....	.....	875	B. G.	0.80	0.48	60	G. E.
..	....	.....	1	.....	.....	171.5	...	....	.....	.....	.....	.....	.....	250	A. G.	0.80	2.4	60	G. E.
..	....	.....	2	1,200	Kaplan	200	24	24	M. S.	L.	Elbow	C. S. E.	.....	800	A. G.	0.80	0.6	60	G. E.
1	1935	.....	..	420	Kaplan	251	17	17	M. S.	L.	.....	.....	.....	375	A. G.	0.80	2.4	60	G. E.
..	....	.....	1	.....	.....	720	...	....	.....	.....	.....	.....	.....	219	A. G.	0.80	0.48	60	G. E.
..	....	.....	1	700	Francis	257	20–28	25	R. H.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
..	....	.....	1	117	Kaplan	277	19.4–8	....	M. S.	W.	.....	Flume	.....	93	A. G.	0.80	0.48	60	E. M.
..	....	.....	2	40	Francis	...	19.4–8	....	J. L.	.....	.....	Flume	Geared to pumps	.....	.....	....	.....	..	.....
..	....	47,500	2	8,500	Kaplan	163.6	42–26	37.5	M. S.	W.	Elbow	Concrete	.....	7,500	B. G.	0.90	6	60	A. C.
			2	220	Francis	415	42–26	37.5	J. L.	W.	Elbow	Concrete	.....	150	Direct current		0.25	..	A. C.
..	....	192	1	192	.....	138	8	8	J. L.	W.	.....	.....	.....	156	A. G.	0.80	0.21	60	G. E.
..	....	.....	1	.....	.....	120	...	....	.....	.....	.....	.....	.....	1,125	A. G.	0.80	4.8	60	G. E.
..	....	.....	1	.....	.....	180	...	....	.....	.....	.....	.....	.....	563	A. G.	0.80	4.8	60	G. E.
..	....	.....	1	300	.....	120	8	8	J. L.	W.	.....	.....	.....	250	A. G.	0.80	0.48	60	G. E.
..	....	.....	3	3,200	Francis	112.5	32–36	32	J. L.	W.	[5]E. S.	Concrete	.....	2,750	B. G.	0.95	6.9	60	W. E.
..	....	.....	3	18,000	Francis	150	109–116	112	I. P. M.	W.	[5]E. S.	Plate St.	.....	14,000	B. G.	0.95	13.8	60	A. C.
..	....	.....	2	17,500	Francis	257	206	194	A. C.	W.	.....	.....	.....	14,500	B. G.	0.90	13.8	60	G. E.
..	....	.....	1	450	.....	200	20	20	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	G. E.
..	....	.....	1	325	.....	225	13	13	J. L.	W.	.....	.....	.....	.....	.....	.....	.....	..	G. E.
..	....	175,000	4	35,000	Francis	150	...	157	I. P. M.	.....	.....	.....	.....	30,000	B. G.	0.85	6.9	25	W. E.
..	....	20,850	2	6,800	Prop.	90	24	23	N. N.	W.	Elbow	Concrete	.....	6,000	B. G.	0.80	4.15	60	G. E.
			1	7,250	Kaplan	90	24	23	I. P. M.	W.	Elbow	Concrete	.....	6,000	B. G.	0.80	4.15	60	G. E.
..	....	20,800	2	6,800	Prop.	90	24	23	N. N.	W.	Elbow	Concrete	.....	6,000	B. G.	0.80	4.15	60	G. E.
			1	7,250	Kaplan	90	24	23	I. P. M.	W.	Elbow	Concrete	.....	6,000	B. G.	0.80	4.15	60	G. E.
..	....	.....	1	.....	.....	133	...	....	.....	.....	.....	.....	.....	625	.....	0.80	0.6	60	G. E.
..	....	.....	1	.....	.....	...	...	....	Replaces existing generator				.....	312	.....	0.80	2.4	60	W. E.
..	....	.....	1	645	.....	200	24	....	J. M.	.....	.....	.....	.....	.....	.....	.....	.....	..	G. E.
..	....	132,000	2	66,000	Francis	112.5	207–130	180	N. N.	W.	Elbow	Plate St.	.....	56,000	B. G.	0.90	13.8	60	W. E.
..	....	360,000	2	45,000	Prop.	85.7	54–43	48	I. P. M.	W.	Elbow	Concrete	.....	36,000	B. G.	0.90	13.8	60	G. E.
..	....	45,000	2	15,000	Francis	171.4	126	110	.....	.....	Elbow	Plate St.	.....	12,500	B. G.	0.80	13.8	60	.....
..	....	1,835,000	4	115,000	Francis	180	584 422	520	A. C.	W.	Elbow	Cast St.	Butterfly	82,500	A. G.	1.0	16.5	60	2 G. E. 2 W. E.
			1	55,000	Francis	237	...	....	N. N.	W.	Elbow	Cast St.	Butterfly	40,000	A. G.	1.0	13.8	60	A. C.
			2	3,500	Pelton	300	...	....	P. W.	W.	House service unit		.....	3,000	.....	0.80	2.4	60	E. M.
2	1935	.....	2	115,000	Francis	180	...	520	P. W.	W.	Elbow	Cast St.	Butterfly	82,500	A. G.	1.0	13.8	60	G. E.
..	....	42,000	3	14,000	Francis	..	222–117	195	.....	.....	Elbow	.....	.....	12,500	A. G.	0.80	6.9	60	.....
..	....	.....	1	1,570	Impulse	257	250	216	M. S.	W.	.....	.....	.....	1,250	....	0.80	2.3	60	G. E.
..	....	.....	1	1,800	.....	180	21	21	J. L.	W.	.....	.....	.....	1,500	A. G.	0.80	2.3	60	G. E.
..	....	.....	1	3,000	Francis	200	...	37	M. S.	W.	Connects to existing generator			.....	.....	.....	.....	..	.....
..	....	.....	1	13,300	Francis	240	...	142	A. C.	A. C.	.....	.....	.....	9,375	B. G.	0.90	6.6	60	G. E.
..	....	.....	2	450	Pelton	600	...	500	P. W.	W.	.....	.....	.....	375	.....	0.80	2.3	60	I. E.
..	....	.....	1	1,600	Pelton	514	...	1,000	P. W.	Connects to existing generator			.....	.....	.....	.....	.....	..	.....
..	....	332,000	2	83,000	Francis	171.5	327–247	310	M. S.	M.S.	Elbow	Cast St.	Butterfly	66,700	A. G.	0.90	13.8	60	W. E.
..	....	665,000	2	66,000	Kaplan	75	67–22	50	M. S.	W.	[5]E. H. S.	Concrete	.....	54,000	B. G.	0.80	13.8	60	G. E.
..	....	.....	1	5,000	Kaplan	257	67–22	50	M. S.	W.	Elbow	Plate St.	.....	3,200	A. G.	0.80	2.4	60	E. M.
..	....	.....	1	100	Pelton	900	...	500	P. W.	.....	.....	.....	.....	62.5	.....	0.80	2.4	60	G. E.
..	....	.....	1	1,450	Pelton	430	510	500	P. W.	A. C.	.....	.....	.....	1,000	.....	1.0	0.75	50	G. E.
..	....	.....	1	156	Francis	450	34	34	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	.....	1	500	Francis	600	70	70	J. L.	.....	.....	.....	.....	.....	.....	.....	.....	..	.....
..	....	33,600	2	11,200	Francis	214.2	145–75	125	A. C.	W.	Elbow	Plate St.	Butterfly	10,000	A. G.	0.80	6.9	25	G. E.
1	1935	6,000	1	1,500	Francis	720	239	222	P. W.	P. W.	.....	.....	.....	1,250	.....	0.80	2.3	60	G. E.
..	....	.....	1	1,400	Francis	720	...	275	P. W.	.....	Connects to existing generator			.....	.....	.....	.....	..	.....
..	....	636,000	4	53,000	Francis	75	83	80	D. E. W.	D. E. W.	Elbow	Concrete	Head Ga.	46,625 43,482	B. G.	0.80 0.85	13.2	60 25	C. G. E. C. G. E.
..	....	.....	2	8,000	Francis	180	83	80	D. E. W.	D. E. W.	Elbow	Concrete	Head Ga.	7,200	.....	0.80	13.2	60	C. G. E.
2	1934	.....	2	53,000	Francis	75	83	80	D. E. W.	D. E. W.	Elbow	Concrete	Head Ga.	43,482 46,625	B. G. B. G.	0.85 0.80	13.2 13.2	25 60	C. G. E. A. C. O.
2	1935	.....	2	53,000	Francis	75	83	80	D. E. W.	D. E. W.	Elbow	Concrete	Head Ga.	43,482	B. G.	0.85	13.2	25	C. G. E.
..	....	4,200	1	4,200	Francis	400	161	156	D. E. W.	W.	Elbow	Plate St.	Butterfly	3,750	A. G.	0.80	2.2	60	S. G. E.
..	....	.....	1	760	Prop.	312	31	29	D. E. W.	.....	.....	Open Flume	Drives 17.5-million g.p.d. centrifugal pump						.....
..	....	.....	1	650	Francis	257	30	30	M. S. I.	.....	.....	.....	.....	.....	.....	.....	.....	.....	E. E. C.
..	....	5,200	2	2,600	Francis	277	70	66	M. S. I.	W.	.....	.....	.....	2,250	.....	0.80	2.3	60	.....
		400	1	160	Francis	220	24	24	J. M. C.	W.	Conical	Open Flume	.....	120	.....	0.80	2.3	60	C. W. E.
1	1935	.....	1	5,000	Francis	514	228	220	D. E. W.	P. W.	.....	Cast Ir.	.....	4,690	.....	0.80	2.3	60	C. W. E.
1	1935	10,590	1	4,300	Francis	360	111–106	104	D. E. W.	W.	St. Conical	Plate St.	Butterfly	3,300	A. G.	0.90	6.6	60	M. P.
		.....	2	1,100	[6]P. M. A.	180	19	19	D. E. W.	.....	.....	Concrete	.....	.....	.....	.....	.....	..	C. G. E.
1	1935	.....	1	19,000	Prop.	150	56	56	D. E. W.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1	1935	.....	..	30,000	Francis	180	...	....	C. A. C.	W.	.....	.....	.....	25,000	A. G.	0.85	13.2	60	C. W. E.
1	1935	Vertical, 300 r.p.m., 60 to 25 cycle frequency changer.							Motor, 61,600 hp., 1.0 p.f., 3 phase, 60 cycle, 13,200 v.					45,000	.....	1.00	13.2	25	C. W. E.
1	1935	Vertical, 300 r.p.m., 25 to 60 cycle frequency changer.							Motor, 61,600 hp. 1.0 p.f., 3 phase, 25 cycle, 13,200 v.					45,000	.....	1.00	13.2	60	C. W. E.
..	....	.....	4	1,000	Pelton	600	...	500	P. W.	.....	.....	.....	.....	875	.....	0.80	11.5	50	G. E.
..	....	.....	1	600	Pelton	514	...	415	P. W.	.....	.....	.....	.....	.....	.....	.....	.....	..	W. E.
..	....	.....	1	900	Francis	360	...	112	P. W.	.....	Connects to existing generator			.....	.....	.....	.....	..	.....
..	....	.....	1	150	Pelton	1,200	...	800	P. W.	.....	.....	.....	.....	.....	.....	.....	.....	..	F. M.
..	....	.....	1	8,700	Pelton	360	...	1,475	P.W.	.....	Connects to existing generator			.....	.....	.....	.....	..	.....
..	....	.....	1	100	Impulse	630	...	200	M. S.	.....	.....	.....	.....	.....	.....	.....	.....	..	G. E.
..	....	.....	1	2,500	Impulse	327	...	280	M. S.	W.	.....	.....	.....	.....	.....	.....	.....	..	W. E.
..	....	.....	3	17,000	Francis	257	...	250	M. S.	.....	.....	.....	.....	17,000	A. G.	0.80	6.9	60	G. E.
..	....	.....	1	.....	.....	375	...	....	.....	.....	.....	.....	.....	25,000	A. G.	0.80	6.6	50	G. E.

[1]The term "New" applies to an entirely new project on a site that has not been developed previously. "Redevelop" indicates a project on a site that has been developed previously and may consist of new wheels and settings or an entirely new plant.

[2]A. C. indicates that the thrust bearing is above the generators rotor; B. G. thrust bearing located below the rotor.

[4]G. C. G. gravity type with control gates; R. C., reinforced concrete; P. & G., piers and gates; R. E. F., rolled earth fill; C. G., concrete gravity; M. A., multiple arch; G. A., gravity arch; C. A. A., constant-angle arch; M. C. E., mass concrete and earth fill with concrete retaining walls; C. A., concrete arch; U. S. N., United States Navigation; V. L. M. G., vertical-lift, removable gates; R. F. C., rock-filled timber crib.

[5]E. S., elbow with splitter plate; E. H. S., elbow with horizontal splitter plate.

[6]P. M. A., propeller type with manually adjusted blades.

HYDRO-ELECTRIC GENERATION

Makes a New Record

Approximately 39.5 billion kw.-hr. generated by utility hydro plants in 1935. Over 1,500,000 hp. of new capacity is being installed in plants designed for an ultimate capacity of over 3,500,000 hp.

MANY new milestones were established in the power field, during 1935. One of these is an all-time generation record in hydro-electric plants about 39.5 billion kw.-hr., or 40% of the total 99-billion kw.-hr. The highest previous output from water-power plants was 34.7 billion kw.-hr., in 1933. This was also the highest per cent, 40.7, of a total generation of 85.4 billion kw.-hr.

At the end of 1934, installed waterwheel capacity slightly exceeded 16,000,000 hp. in the United States and in Canada, 7,547,000 hp. The United States figure did not change much during the last year, as practically no important units have been put into service. A study of the table on pages 8 and 9 will show that there are over 1,500,000 hp. of waterwheels being installed at present, in the United States, about 50% of which will go into service this year. The ultimate capacity of these plants is more than 3,500,000 hp. These figures begin to look like boom years.

In Canada, the chief increase in hydro-plant capacity was in the Beauharnois plant on the St. Lawrence River, where three 53,000-hp. units were started. This makes a total of eight main units, and two 8,000-hp. service units, in this plant. Two more main units are on order to complete the initial development, which is planned for over 2,000,000 hp. ultimately. The Hydro-Electric Commission of Ontario is completing its Abitibi-Canyon plant, installing three more 66,000-hp. units, making the capacity 330,000 hp.

Business conditions in water-power developments improved in 1935 in the United States, even though some promising prospects at the beginning of the year failed to materialize. The Grand Coulee development in Washington, which was to be a low-dam power project, has been changed to one that will build the foundation of the high dam and no power development. The high dam will eventually be completed, and provide for installation of 2,700,000 hp. The project also includes an irrigation-water pumping plant that will require 660,000 hp. to operate. When all this will be done is still in the laps of the gods.

Parker Dam, being built about 150 miles below Boulder Dam, will not have any power equipment installed at present, but provisions will be made for approximately 110,000 hp. The Buzzard's Roost project, a 20,000-hp. development in South Carolina, is awaiting court action as to its legality.

In 1934, the United States Senate failed to ratify a treaty with Canada to develop the international section of the St. Lawrence River, a 2,000,000-hp. project. At the beginning of the year it was expected that another attempt would be made to have this treaty approved, but nothing has been done.

In spite of all this, water-power business improved during the last twelve months, as previously mentioned. Large projects, for which equipment had been ordered, that have been tied up for several years, are now being completed. Large orders have also been placed for new equipment to be installed in other plants.

Work on Boulder Dam project has pushed forward rapidly. The dam is completed, and power-house construction has progressed so that initial operation will start this year, one year ahead of schedule. Orders have been placed for two more large units for this project. These make a total of six 115,000-hp., and one 55,000-hp. units aggregating 752,000 hp., including two 3,500-hp. service units. Other projects scheduled for operation next year are Monroe and Columbus projects of the Loup River Public Power District, totaling 64,500 hp.; and the Sutherland development of Platte River Public Power & Irrigation District, with an initial capacity of 35,000 hp. All three are in Nebraska.

In the Tennessee Valley, Norris and Wheeler projects of TVA are nearing initial operation. The former will bring in two units aggregating 132,000 hp., and the latter 45,000 hp. A second 45,000-hp. unit has been ordered for Wheeler, which is laid out for eight machines. The wheels are of the fixed-blade propeller type and have the largest capacity of their kind.

At Bonneville, near Portland, Ore., two 60,000-hp. Kaplan turbines are being installed in a plant planned for 600,000 hp. These plants are almost 50% greater in capacity than the 42,500-hp. machines installed at Safe Harbor plant on the Susquehanna River, which are the largest in operation.

Research in cavitation phenomena in several laboratories continues to be active, and is making real progress. It has been established that these studies are based on a sound scientific and engineering foundation. A great deal of work remains to be done before a complete understanding of these phenomena can be established, but much has been accomplished that is of practical and engineering value. Research to find out what metals best resist effects of cavitation has progressed to where their characteristics are known. Announcement of results of this work will probably be made soon.

POWER BRIEFS OF 1935

BETTER WATER

● PERHAPS the greatest chemical surprise of the year was Prof. Straub's announcement that pure sodium hydroxide alone will not cause "embrittlement" of boiler steel, that certain other impurities must be present also. At least one of these accessories in crime has been spotted—sodium silicate. Ordinary water holds enough silicate to make the hydroxide do its work, so customary precautions (notably maintenance of the A.S.M.E. sulphate-carbonate ratio) must be continued until something better is found.

During the year sodium sulphite won additional support as a method of halting boiler corrosion by removing the last traces of dissolved oxygen from feedwater.

CLEANER AIR

● AMERICA trailed England in the battle against "smoke," atmospheric dust and sulphur fumes, but displayed progress here and there. Fuel users of Hudson County, (N. J.) saved more than $750,000 as a direct result of smoke-abatement activities.

Back in 1933, Seattle Gas Company installed photo-electric smoke alarms. The equipment and its operation were continually improved, and with it operation. By June, 1935, smoke periods had been reduced to less than one minute per hour. Complaints evaporated.

New dust catchers continued invasion of American plants—for example, an inexpensive Venturi-type dust trap made to fit inside of an existing duct. Another new film-type unit comprises nest of tubes spirally corrugated on the outside. All parts contacting flue gas or water are corrosion-resistant.

FUEL APPRAISAL

● EARLY in 1935 A.S.M.E. and A.I.M.E. set up a top-notch joint committee on fuel values with 16 members divided equally between users and producers of coal. The committee prefaced its activities with the statement that it is impossible to set up any scale to reflect accurately the relative value of different coals for steam production, but that it expected to collect experience data to assist users in selecting the proper coal.

PIPING PROGRESS

● AMERICAN Standards Association approved the American Standards Code for pressure piping. This correlates regulations for design and installation of piping systems with suitable dimensional standards and material specifications. It is primarily a *safety* code.

With aluminum foil already established as a heat insulator, sheet steel crashes the field. Sheets of unpolished commercial steel are used. Crimps insure rigidity and spacing of layers.

A notable development, made public in 1935 after several years' testing of experimental installations, was an extremely compact steam trap with a single Monel-metal moving part. Other features: extreme compactness; no thermostat; no float.

WELDS AND SPRAY

● FUSION welding and metal spray continued the steady advance of recent years with new and improved coated rods and arc-welding machines, better gas torches, improved welding technique, far more powerful X-Ray machines and foolproof spray guns. Early objections to welded boiler drums practically disappeared. Welded boilers were universally accepted for all pressures. A new kink in welding fittings was a welding ell formed from a plyplate having thin inner or outer surface (as desired) of 18-8 stainless steel on carbon-steel foundation. During the year the applications of metal spray increased rapidly, and it took its place among the established tools of the power engineer, both to build up thickness and to apply protective coatings of lead, zinc, copper, aluminum, etc.

TAILORED WEATHER

● JOHN Public talked a lot about air conditioning in 1935, but the engineer kept a jump ahead of him with equipment.

Several new models of air-conditioning equipment saw the light. These included self-contained units comprising compressor, evaporator, air-cooled condenser, expansion valve, refrigerant and oil system.

For really clean air, clean enough to stop hay-fever sneezes, one maker brought out a dry-type air filter, consisting of a filter cartridge of especially processed cotton pleated to give over 30 sq.ft. of filter area in a frame 20 in. by 30 in. by 4 in.

In congested city districts, indoor cooling towers made further progress. Singer Building, New York, installed one in the basement to cool water for its new diesel engine.

Water-vapor won new converts as a refrigerant for air conditioning. Hayden Planetarium used it for artificial cooling of the air beneath its artificial sky.

WON'T STAY DEAD

● THE gas turbine, periodically pronounced dead, popped up again as a lively infant. William Trumpler's experimental unit used the same blades for both compressor and turbine, thus solving eternal problem of blade cooling. Unit is simple and cheap.

CATHODE DETECTIVE

● LATE in 1935 the cathode-ray oscillograph, delicate precision tool of electrical engineering, found a new use. It was given a memory. The new electric detector, standing guard over a transmission line, constantly traces its curve on a fluorescent film, which retains the record for a period of 15 seconds. When lightning strikes the line, a Thyratron tube opens a camera shutter and takes a time exposure of the fluorescent "slate" before the image has time to fade. The photo-electric cell, another electronic device, found continuously increasing applications in power plants as in industry, to record and to control.

ANTEDELUVIAN

● JUST before the beginning of 1935, 454 better-than-average industrial plants, surveyed by *Power,* reported on 13,329 items of power equipment of which 65% were more than ten years old and 43% were more than 20. It is safe to say that 1935 ended with more than half of America's industrial power equipment completely obsolete, a major cause, along with poor operation, of an annual power-dollar loss approximating $750,000,000. Even with the most optimistic figuring, it is obvious that the great majority of obsolete equipment existing at the beginning of 1935 is still in operation, one year older, and one year further away from best available practice.

TRANSATLANTIC FLASHES

Glimpses of Progress That is Changing the Power Map of Europe

GREAT SHIPS

● IN 1935, Europe floated its most elaborate and stupendous contraption straight across the Atlantic to prove to all neighbors of Missouri that "U. S. record" is not necessarily synonymous with "world record." Specifically the liner *Normandie,* greatest moving object ever made by man, costly monument to French pride. This 79,000-ton luxury liner first docked in New York on June 3. Twenty-nine oil-fired water-tube boilers supply 400-lb. steam to four 40,000-kw turbo alternators. Four 40,000-hp. synchronous motors are direct-connected to the four screws. Meanwhile 1936 finds Britain rushing completion of the huge "Queen Mary," which will sail in May.

LIQUEFIED COAL

● SEVERAL plants in various parts of the world are pumping hydrogen under heat and pressure into the molecules of heavy oils to make gasoline, but only Britain is thus liquefing bituminous coal on a commercial scale. Ramsay MacDonald opened the Billingham plant in October. Treated with hydrogen under high pressure and temperature, the coal yields from 50 to 70% of its weight in gasoline—a costly product, but a start in making Britain independent of foreign supplies.

BOILER BRIEFS

● ALTHOUGH welded boiler drums are becoming an old story in America, England reported what was said to be the first boiler in that country to incorporate fusion-welded drums. The unit, of 2,750 sq.ft. heating surface, has a working pressure of 415 lb. Drums were welded in accordance with the American A.S.M.E. Boiler Code.

Italy ordered a 40,000-lb.-per-hour high-pressure Loeffler boiler for the steamer *Conte Rosso.* Two high-pressure turbines are being installed, one coupled by gearing to each propeller. The two turbines will operate in series, the first at 1,900 lb. pressure. Repeat orders for Loeffler boilers were received from Moscow and the German Dye Trust.

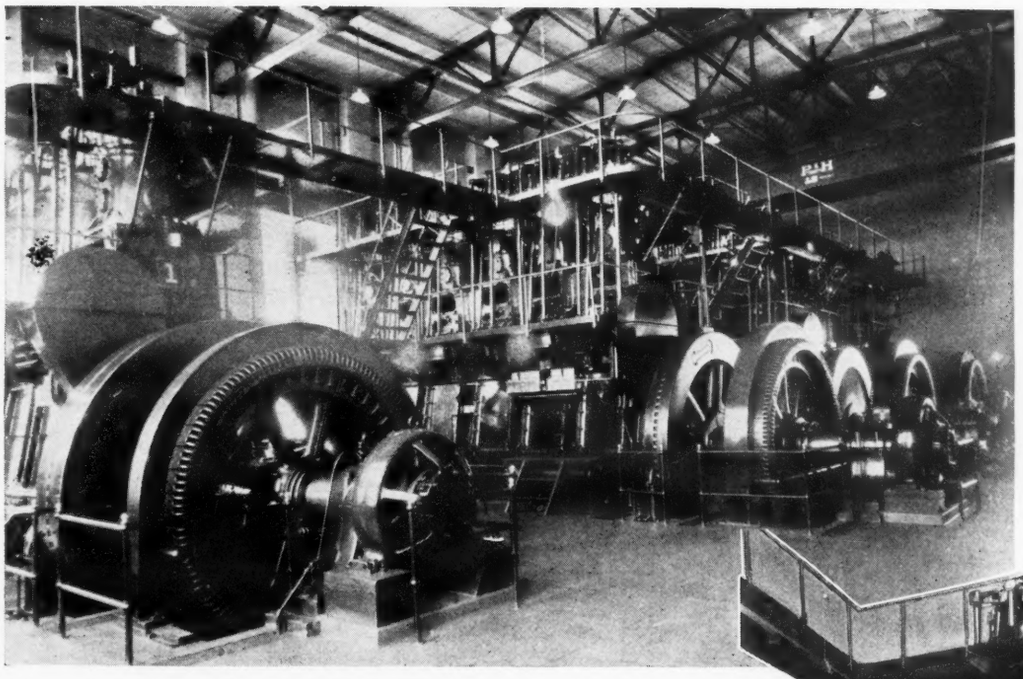
THOU SHALT NOT SMOKE

● THE British have been taking smoke seriously, forcing new central stations in London to invest $5 or more per kilowatt to launder stack gases. Battersea reported fine results with its elaborate installation—the Howden I.C.I. system. As far as Great Britain is concerned, the stack top completely without smoke, grit, dust or acid compound is rapidly becoming standard central-station practice.

At Battersea (now of 160,000 kw., with another 100,000 kw. being installed) all flue gas is scrubbed with 20 tons of water per ton of coal, followed by the use of a small amount of lime to remove the sulphur.

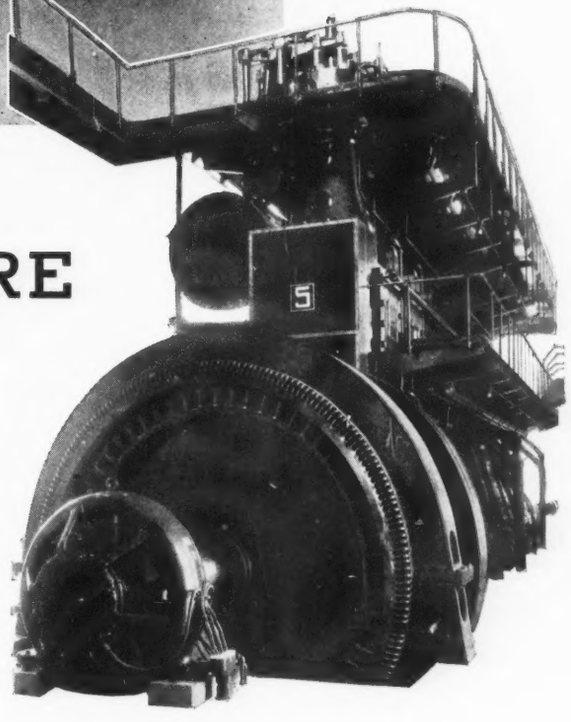
In June the first 60,000-kw. section of Tir John Station began operation in South Wales. The plant for removing acid-sulphur compounds from flue gas is similar to Battersea installation, using a lime cream in a specially designed scrubber plant. It is claimed that the equipment removes 96% of dust, 96% of total sulphur in addition to 95% of the sulphur acid, and 60 to 90% of the nitric acid. Precipitated sludge (largely calcium sulphite) together with ash, is discharged into a marsh.

Tir John, incidentally, contains four 280,000-lb. per hour boilers, with pulverized fuel, superheaters, economizers, air heaters and balanced draft. Steam is generated at 625 lb. and 850 deg. F.



Left — Units 1 to 4 in the older part of the plant

Below — Unit No. 5, largest 4-cycle, vertical, air-injection, crosshead-type engine



ROCKVILLE CENTRE REPORTS

After seven years of diesel plant operation, here are the operating and maintenance figures

By J. W. Anderson

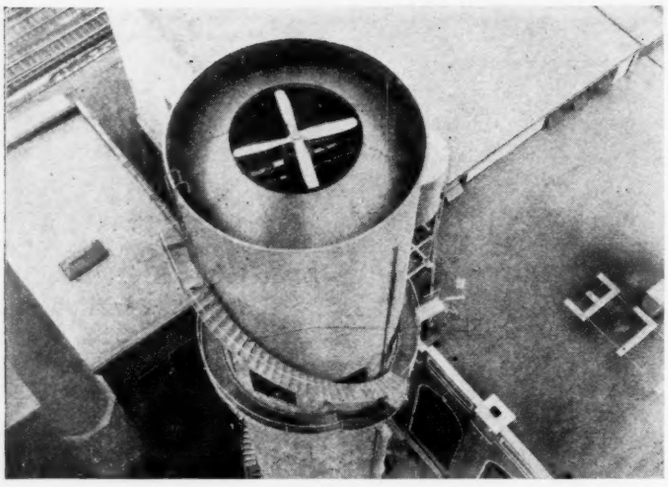
ROCKVILLE CENTRE, N. Y., has one of the well-known municipally owned and operated diesel stations. Diesels superseded steam there in 1928. A commuter's town about 20 miles out of New York, Rockville Centre has grown steadily through the depression, and its station has grown with it.

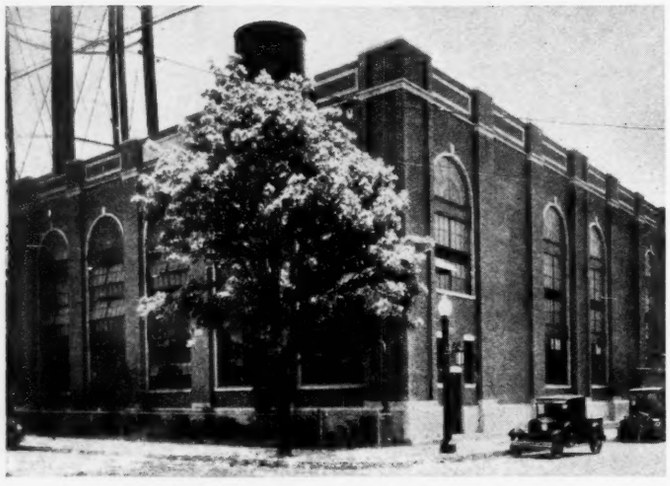
The plant has been fully described previously, so equipment only is listed here. Originally three diesel sets were installed, an 825-hp., 4-cyl., 23x32-in., 164-r.p.m., 900-kva. unit, and two 1,250-hp., 6-cyl., 23x32-in., 164-r.p.m., 1,060-kva. units. In 1930, a third 1,250-hp. unit was added. In February, 1933, a fifth unit was placed in commission, a 2,865-hp., 8-cyl., 29x48-in., 120-r.p.m., 2,500-kva. engine. All are single-acting 4-cycle, air-injection, crosshead-type units. Generators are 2-phase, 60-cycle, 2,300-volt, direct-connected machines with direct-connected exciters.

A sixth unit, duplicate of the fifth, has been ordered, and is expected to be in service within the year or less.

Rockville Centre is a strictly residential community, so some 70% of total power output is for residential and store use. The other 30% is used for street lights, pumping the water supply, and sewage disposal pumping. A typical load curve is shown. The peak is eased somewhat by cutting out the municipal water-supply pumps for the time being and utilizing water-storage capacity. Then night load is increased by running the pumps to refill storage tanks. Sewage pumps are automatic and float-controlled.

Heavy-duty, slow-speed equipment was chosen very deliberately because the management believes it will give greatest reliability and economy over a long life. In other words, the permanent character of the plant warrants placing the emphasis on over-all power costs over the long period of years. As for the reliability of operation, the very safety and health of the community





Top—The cooling tower, a converted water tower. Above—This station houses 7,445 hp. in diesels, to which 2,865 more will soon be added

depend upon it. Much attention to these considerations is shown in installation and operation of the plant.

Operating costs in mills per net kw.hr. have been:

	1929	1930	1931	1932	1933	1934
Fuel	5.38	5.30	4.46	3.97	3.75	3.67
Lubricating oil	0.55	0.38	0.30	0.27	0.24	0.28
Attendance & superintendence	3.83	2.83	2.55	2.35	2.43	2.38
Supplies & water	0.88	0.74	0.63	0.52	0.21	0.19
Engine repairs	0.74	0.56	0.49	0.35	0.48	0.54
Other repairs	0.40	0.48	0.38	0.14	0.09	0.16
Totals	11.78	10.29	8.81	7.60	7.20	7.22

Fuel is Number 5 in the A.S.T.M. specifications, and about 12.0 gross kw.-hr. are produced per gallon at 78% running plant capacity factor. Under present arrangements, fuel is trucked to the power plant from tidewater, but since the plant is alongside railroad tracks, fuel delivery by tank car is optional.

The lubricating-oil system on the engine is protected by wire mesh or metal-edge type filters, but in addition oil is removed from each engine system every 1,500 to 2,000 hr. and put through a special process of cleaning.

It is pumped to a settling tank. Any heavy sludge which remains in the bottom of the engine-oil tank is thrown away. Oil remains in the settling tank for several days. On the side of this tank are several outlets at various heights. Beginning at the top, oil is drawn off from the several outlets until the black oil begins to come. Oil from the upper part of the tank goes to another tank for heating to about 180 deg. F. to be centrifuged. This clean oil is returned to the engine crankcase. Any sludge is thrown away.

The black oil goes to a special tank, where it is permitted to settle for two or three months. Then water is turned into the bottom of the tank very slowly, and as the oil rises, it overflows at the top, a shallow saucer-like pan painted white, with a drain in the center, which leads to the tank for heating the oil for centrifuging. As soon as the black sludge begins to appear, the water is shut off, and the sludge and water drained to waste. Clean oil (from the centrifuge) from this part of the process is used for hand oiling. All new makeup oil is added to the crankcase systems. Over-all station lubricating oil economy is 2,600 gross kw.-hr. per gal.

Cooling water for the engines circulates in a closed system, and is cooled in a special cooling tower made from an abandoned water tower standing alongside the power station. Makeup water comes from the village water-supply system. This water comes from deep wells, and a small amount of soda ash is added before use in the cooling system to definitely neutralize the very slight acid tendency of the natural water.

Strict maintenance of a frequency of 60 cycles in a station of this character is important in order to satisfy the local users of electric clocks. The problem is simplified by the gradual changes of load which are characteristic under the local conditions. The largest motor on the system is a 150-hp. unit driving one of the municipal water pumps. Speed adjustment is under control of the engineer at the switchboard, and in order that he may know the status of affairs at all times, there is a large electric clock operated from station current directly below another large clock operated from a Western Union time circuit. These clocks are at one end of the switch board, in plain view, and comparison is easy. Thus any variations or accumulative errors are quickly observed and corrected.

Much attention is given to operating attendance and proper maintenance. A crew of fourteen men are available for this work, although not all put in full time in the plant. They are:

4-12 P.M. (Peak period)

1 chief engineer
1 asst. engr. in charge of maintenance.
1 first-class operating engineer in charge and who handles the switchboard
1 second-class operating engineer on the floor
1 oiler

12-8 A.M.

1 engineer, 1 oiler.

8 A.M.—4 P.M.

1 engineer, 1 oiler.

Other help

1 relief operating engineer so that every man has one day off per week.
1 full-time maintenance man
2 part-time maintenance men (much of their time is spent in water-department work)

1 janitor (and the station plainly shows the results of his activities).

The following maintenance schedule (rather rigidly followed) has been adopted as the result of experience with these engines under operating conditions prevailing at this station. Parts mentioned are examined and reconditioned as necessary after the operating intervals listed:

	Hours
Fuel valves	1,200
Exhaust valves	1,600
Air intake valves	3,000
Starting air valves	6,000
Fuel pumps	4,000
Governors	3,000
Valve motion	8,000
Main cylinders and pistons	5 to 6,000
Water jackets	5,000
Crankpin bearings:	
check clearance	2,500
check clearance and disassemble	5 to 6,000
Crosshead pins	6,000
Main bearings	6,000
Lubricating oil pump and system	3,000
Crankcase lubricating oil reconditioned	1,500
Air-compressor valves	1,400
Air-compressor crank and piston-pin bearings	2,500
Air-compressor pistons and rings	5,000
Air-compressor intercoolers	6,000
Crossheads and guides	1,500

Modifications are made in this schedule for two reasons. In anticipation of the peak-load period during the winter, all equipment is placed in the best possible condition even if it is necessary to go over some parts sooner than indicated by the schedule. Similarly, the summer vacation period is anticipated and heavy maintenance work during this period is avoided.

In order to keep complete control over this work, every important part of all the engines has its own card in a special card index. Any examinations or work done is described on these cards, thus each card tells the complete story of that part. In addition, a summary sheet is made up every day showing the parts worked on, what was done, and the time spent.

One of the best guarantees of reliable and economical maintenance is the well-located and very completely equipped repair shop. Every provision is made to handle routine and emergency work readily and promptly. It reduces the cost and also the time required. The latter is especially important on breakdown.

A 15-ton crane services units 1 to 4 inclusive and delivers any parts from them to the 20-ton crane which runs at right angles to the former and serves units 5 and 6 as well as the repair shop, which is located in the corner of the power house alongside unit No. 5.

The repair shop has two floors, is open above the second, and has a hatch in the floor so that the crane can drop parts right down through to the first floor. This first floor has the following machines: 14-in. lathe, drillpress, power hacksaw, power press, motor grinder, workbench and vises. The second floor has a 30-in. lathe, 18-in. shaper, 6x14-in. grinder, drill grinder, 24-in. milling machine, 36-in. radial drill, and a high-speed drillpress.

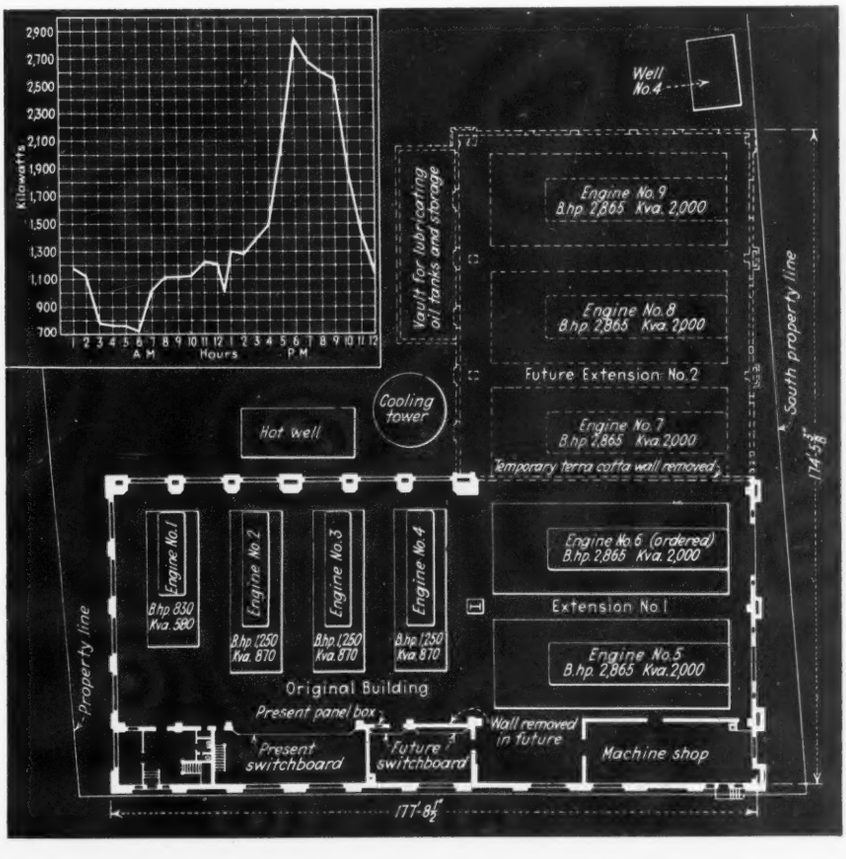
Additional repair equipment includes, oxyacetylene cutting and welding equipment, portable grinding outfit, woodworking tools, equipment for cutting and threading pipe up to 8-in. in dia., complete blacksmith shop (one of the station crew is a blacksmith by trade), hydraulic jacks from 1 to 20 tons capacity, 5-ton dolly crane, chain falls of from ½ to 3 tons capacity at half-ton intervals, and a complete set of Roebling wire rope cable tackles up to 25 tons capacity. Many of these tackles are made especially to handle certain parts or pieces of equipment.

Of course there are ample bins for supplies and stores. There is an extensive stock of steel rods and bars. An important item easily overlooked is several portable lamps and flood lights so that ample illumination can be had when and where it is wanted.

When considering the maintenance figures given in the tables, it should be remembered that none of the engines has operated long enough to go through a complete cycle of maintenance, including replacement of the heavy parts. To date, the various engines have operated a total number of hours as follows:

No. 1—17,123
No. 2—32,382
No. 3—28,082
No. 4—17,538
No. 5— 4,264

Three of the five engines are fitted with waste-heat steam boilers. Safety valves are set for 15 lb., but no more than 5 or 6 lb. is ever carried nor is more than a portion of the exhaust heat available ever used in order to heat the station very comfortably in any weather.



A typical load curve and the station layout

Radial-Blade wheels—1. Center-plate, welded wearing pads. 2. Rimless, bolted blades. 3. Spider, bolted blades

DRIVE FIXES

First of two articles on induced-draft fans, proving they are not limited to any one type. The second next month

INDUCED-DRAFT specifications often are so written that they force selection of a fan contrary to the best advantage of the user. This is because of a misunderstanding of relative values or importance of certain peculiarities of various types of fans.

Fan theory has been misleading, because it has been built around the fan alone. When fan theory is altered to encompass the system characteristic together with fan performance, this theory then begins to agree with what now has been discovered from experience and practice. The difference between fan theory and practice has been the confusion between essentials and non-essentials of fan characteristics, like the advertising manager of a certain cigarette that expected a particular baseball team to win the World Series because the players smoked his brand of cigarettes.

Assuming a fan is correctly proportioned, rated, designed and built, the following facts have been found to be true:

1. Aside from mechanical consideration, any of the common fans such as the backward, radial, forward and radial-tip-blade types are suitable for induced-draft work when built either double-inlet with inlet boxes or single-inlet with or without boxes.

2. Any of these types of fans can be operated in parallel, without causing hunting, surging and without damaging a motor even though that motor is selected without any great factor of safety as to horsepower.

3. The main considerations in what type is selected for a given job are these: kind of drive used—steam turbine or engine or electric motor; static pressure and gas temperature.

This viewpoint is opposed to the theory that fan selection is guided by idiosyncrasies of a particular type of fan.

Practical Examples

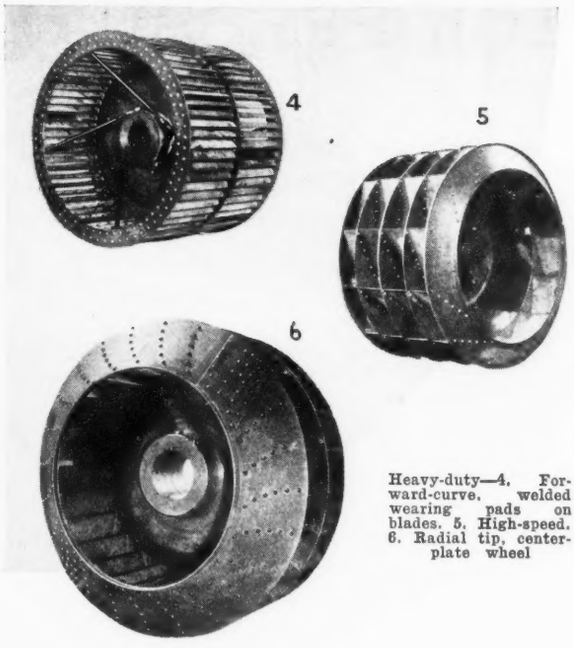
A few examples of a practical nature will illustrate some of these points and clarify the matter before any question of theoretical demonstration is attempted. There is a definite place for each type of fan; no one type of fan can hog the road entirely. A first-class fan manufacturer will have available all types for various applications, just as a first-grade golf player will have a complete set of clubs, each for different types of shots for various ranges. The "shot" of a direct-connected fan is mainly its r.p.m. Wheel-tip speed is its limit of operation. For example, no one would want to run a steam turbine 350 r.p.m., hence would not use the large-wheel-diameter, narrow-paddle-wheel fan that would be selected for direct connection to steam engine. Likewise, however, if a turbine drive must be used, one should not refrain from using the high-speed fan, within sensible duty limits, merely because the air is dusty. The high-speed fan has been used successfully for dusty air for some years with static pressures up to 6 in. and temperatures up to about 600 deg. F.

Use of Motors

When an electric motor is used, there is no flat rule for r.p.m., as this in turn depends upon the power of the motor. The advantageous speed of a 50-hp. motor is one thing, of a 250-hp. another, and of a 1,000-hp. quite a different matter.

If the gas volume is around 80,000 c.f.m. to 250,000 c.f.m. at approximately 400 deg., and pressure is above 6 in. static pressure, the forward-curved fan adapts itself most readily to direct-connected motors because its speed characteristics match that of the motor. This combination of volume and pressure also adapts the radial-tip fan to motor drive. However, above 12 in. static pressure wheel-tip speed of this fan becomes excessive. But an induced-draft fan to handle around 100,000 c.f.m. at a pressure of about 1 in. static and 500 deg. would produce a very low r.p.m. if a forward-curved radial or radial-tip fan is used. The low pressure allows the use of a backward-blade, high-speed fan which about doubles the r.p.m. over the forward-curved fan and provides a more advantageous direct-connected motor speed.

In this case, horsepower is about 25, tip speed about 7,000 f.p.m. However, if the static pressure is 6 in., the tip speed becomes about 16,000 f.p.m., which is in the upper desirable limit for the high-speed fan from an operating standpoint. Here the designer would switch instead to the forward-curved fan to obtain a nominal fan r.p.m. and tip speed and simultaneously to avoid an acute problem in the design of suitable



Heavy-duty—4. Forward-curve, welded wearing pads on blades. 5. High-speed. 6. Radial tip, center-plate wheel

FAN TYPE—I

By M. S. Kice, Jr

Head Industrial Division
American Blower Corp.

shaft and bearings, if the fan is double-inlet with inlet boxes.

High-temperature work is becoming quite common for induced-draft fans of various kinds, more especially in furnaces where these fans are handling gases from 800 on up to 1,300 deg. One would not specify a high-speed fan in this case because the other types lend themselves better to structural design. The flat high-speed fan blade lies in a plane where it is subjected to bad bending stresses, hence when it becomes red hot it will fail. Common sense would dictate the lowest-stress design and also would select that design that requires a minimum of weight of very expensive alloy material, hence the forward-curved fan is quite proper for elevated temperature work. However, when the forward-curved fan wheel for smaller jobs becomes less than around 24 in. in diameter, the blades have to be too thin and too narrow to resist this heat. Hence, in the smaller size, the radial-blade fan is a better choice because this fan having a few blades can be designed with each blade thick enough to hold up against severe temperature.

"Non-overloading"

Specification writers have become quite intrigued with the word "non-overloading," and some specifications have been written for "non-overloading induced-draft fans." The high-speed fan has been used for induced-draft work, not to prevent a possible motor overload, but to obtain an economical fan r.p.m. for a given drive, as has already been stated.

The fallacy of the "non-overloading" characteristic of a high-speed induced-draft fan is this: Since the fan handles high-temperature gases, when these gases are cooled the horsepower goes up in direct ratio to the decrease in absolute temperature. Thus, an induced-draft fan, designed for 600 deg., when working at 70 deg. will overload 100% regardless of what kind of fan is used. The word "non-overloading" is erroneous for induced-draft work.

This system operates cold first when a new boiler is being dried out, and it is quite important to have a fan available for drying out a new boiler, or when any cold boiler is started up after having been off the line. In this case, the practical remedy to protect the motor from overload is either the use of variable-speed drive or constant-speed drive with dampers.

The practical conclusion is to select for a given job the fan that is the most economical during its entire life considering properly evaluated first cost, maintenance cost, space required, and operating cost of the unit representing the fan, transmission and drive.

Thus, the particular type of fan that would be selected depends upon physical condition of gas volume, static pressure, gas temperature to provide the correct speed in r.p.m. for the desired type of drive, and does not depend upon any alleged "magic" characteristics of any type of fan.

The second half of this article will discuss fan characteristics in greater detail.

Turbine Governor Fails

FAILURE of a turbine-governing gear resulted in the almost complete wrecking of a 5,000-kw. machine at Dowlias, South Wales. Normal speed of the machine was 3,000 r.p.m., but when the governor failed, it rose to over 4,000 r.p.m. Steam pressure was 200 lb., temperature 650 deg. F. Governing system consisted of a spring-loaded governor, a rotary oil pump driven from turbine shaft supplying oil to each throttle valve.

An emergency governor consisted of a spring-loaded plunger housed in the turbine shaft which, at 10% above normal speed, should be ejected by centrifugal force and through a bell-crank lever trip the stop valve.

Examination after the accident showed that the plunger had been ejected, but that the spindle had not turned so therefore the emergency governor had not acted. The part was found to have seized, partly due to dirt and carbonized oil, partly to expansion when heated. Excessive speed was due to the shearing of a small screwed bolt from which the governor links were suspended, and bending of another similar bolt to which the fork of the link gear was connected.

This accident shows the importance of keeping oil in the governor system clean and making regular tests.

NEW USES FOR BACK-PRESSURE

Possibilities of the back-pressure regulator have been greatly extended beyond its primary purpose of exhaust—steam regulation, and in some instances the entire turbine has been built around it

IN THIS article, it is my intention to indicate some less-familiar uses of a familiar unit—the back-pressure regulator. Fig. 2 shows a typical back-pressure regulator and its hookup. It will be seen that the varying force, due to pressure in the exhaust steam line exerted through the diaphragm against the resistance of a weighted lever, fixes at any moment the position of a control valve which is piped into the main governing system of the turbine in such a way that the position of the control valve determines the amount of opening of the main governing valves. (The diaphragm may be replaced by a piston or a sylphon bellows, depending on design requirements or the practice of different manufacturers). It follows that an increase in exhaust demand shown by a tendency of the pressure to drop is immediately transmitted to the inlet valves, which open sufficiently to meet steam requirements. The back-pressure regulator, in short, operates in conjunction with the main governor to admit steam solely in response to exhaust steam demands and not in response to load or speed requirements.

When the regulator is in operation, speed governing is done by other units operating in parallel, which maintain the frequency and carry any deficiency in load. If, however, process requirements would develop more power than the total connected load, the speed governor, always in reserve, takes hold and reduces steam flow to an amount which will just carry all the load. The main thing to remember, omitting details, is that the back-pressure regulator always operates to maintain exhaust requirements and pressure within the limits of the capacity of the turbine to pass steam and capacity of the system to absorb the resulting load.

3-Stage Water Heating

An interesting variation in the use of the back-pressure regulator came up in connection with a water-heating installation for a southern oil company. This company had a large and fairly constant supply of water to heat to 210 deg., using steam from a 150-lb. source. Consideration of efficiency, in this case the desire to generate the maximum amount of byproduct power, made it necessary to heat the water in three equal stages. Turbine construction and the heating layout for this are shown in Fig. 2. The keynote of the arrangement was the use of the back-pressure regulator to control final water temperature. Without any regulator, pressure at the extraction points, hence temperature of the water, would vary with the load.

It was desirable to maintain a constant water temperature and carry the maximum byproduct load. This was achieved by using a back-pressure regulator at the high-pressure extraction point. The regulator was set to hold a pressure of about 15 lb. (213 deg.) which was ample to keep the desired temperature in the heater. As a result, no matter what variation in the amount or temperature of the inlet water, the desired exit temperature was maintained, the load on the unit being varied automatically to suit. Other generating equipment controlled frequency and made up the deficiency in load.

Combination Set-up

In some cases, an industrial plant, operating without a central station tie-in, may have a moderate demand for process steam coupled with a load of such magnitude that a considerable portion of it must always be carried by condensing turbines. The simplest answer to such a problem is the automatic bleeder turbine, but bleeder features add to the cost and introduce losses. A special arrangement of a straight condensing turbine may sometimes be worked out with the help of the back-pressure regulator to permit bleeding over a limited operating range with pressure control.

Such an arrangement of the turbine and back-pressure regulator is shown in Fig. 4 and a typical example of the possible operating range is shown in Fig. 1. The turbine is a simple straight condensing unit with a bleeder connection into the annulus following the first stage (or stages) and provided with an oversize throttle and first stage capable of passing the additional bleeder steam. Pressure control is furnished by a back-pressure regulator connected into the bleed point and operating on the main governor to vary steam flow and keep pressure at the bleedpoint constant. Flow of steam through the stages following the bleed point is directly proportional to the pressure producing it, so that a constant bleeder pressure predicates a constant flow to the condenser.

Refer now to the performance curves, Fig. 1, which were made up for a 750-kw. unit bleeding at 2 lb. pressure. Note that the turbine design is such that a bleeder pressure of 2 lb. (16.7 lb. abs.) produces a flow of 5,700 lb. of steam per hr. to the condenser we shall see that bleeding can start at 375-kw. load when the steam flow all the way through the turbine is 5,700 lb. per hr. Suppose it is desired to bleed 10,000 lb. per hr. Follow curve *AB* up to a total steam flow of 15,700 lb. then the resulting load is 712-kw., 375 kw. of which is carried by the condensed steam and the balance, 337-kw., is generated by the bled steam at a heat rate (figured on the coal pile) of perhaps 4,600

REGULATORS

By Norris D. Gove

Design Engineer
Westinghouse Electric & Mfg. Co.

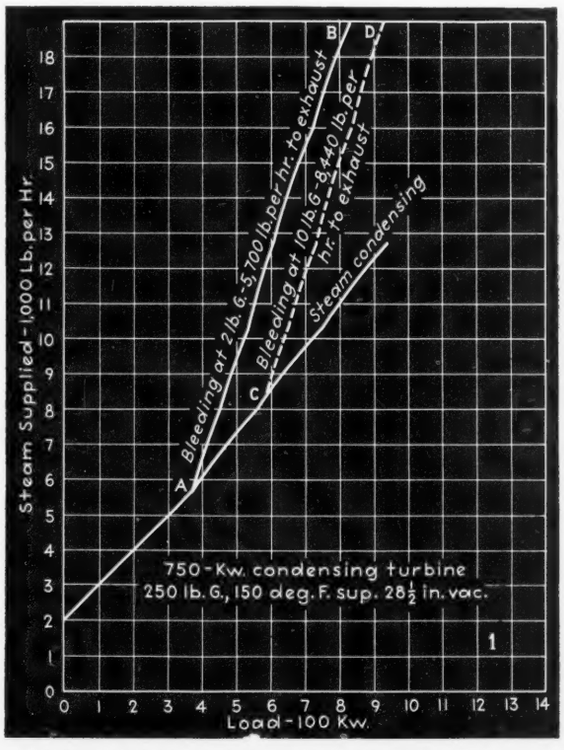

Steam Supplied - 1,000 Lb. per Hr.
Load - 100 Kw.
A
B
C
D
Bleeding at 2 lb. G. - 5,700 lb. per hr. to exhaust
Bleeding at 10 lb. G. - 8,440 lb. per hr. to exhaust
Steam condensing
750 - Kw. condensing turbine
250 lb. G., 150 deg. F. sup. 28½ in. vac.
1

Fig. 1—Steam consumption when bleeding under back-pressure regulator control

B.t.u. per kw.-hr. Low cost of this byproduct power is only slightly offset by the extra cost of the back-pressure regulator, which can usually be installed in modern machines for less than $500.

When bleeding at 2 lb. g., the turbine must always operate along line *AB*, and power generated is fixed by the steam bled (throttle flow minus 5,700 lb). It follows that the connected load must always be greater than 375 kw. or no bleeding can be done, and that it should be equal to or greater than the value set by the bled steam so that it will be unnecessary to take steam direct from the boiler without byproduct power recovery. Power demands greater than those met by this arrangement must be carried by another unit which takes care of load swings and maintains frequency.

If we refer again to Fig. 1, we see that the regulator can be reset for other bleeder pressures. Line *CD* shows the operating range when bleeding at 10 lb. pressure from the same turbine. The flow to the exhaust is then 8,440 lb. per hr. $(5{,}700 \times \frac{24.7}{16.7})$. It follows that, if we are not particular about the bleeder pressure, we can relocate the operating range somewhat by setting the regulator for another pressure.

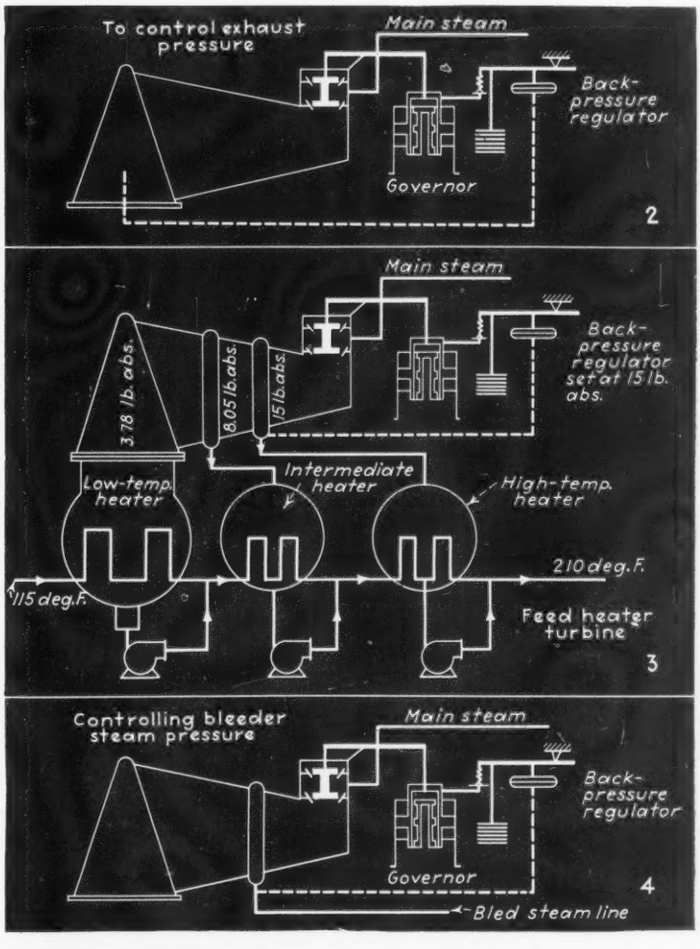
A nice arrangement, particularly in a new plant where there are no old units to carry load swings and to form a reserve, consists of two duplicate units. Each machine would be arranged as shown above, but the regulator of one would be left out of service. Then steam could be bled from one turbine while the other operated non-bleeding. In the event of failure of either unit the other would carry the load, operating straight condensing, and the steam for the bleeder system would be supplied direct from the boilers.

Bleeding under back-pressure control as described above can be undertaken only after a careful study of its limitations. The automatic bleeder turbine can operate alone and can ordinarily be bled throughout its whole operating range without attention or adjustment, but the turbine equipped for bleeding under back-pressure regulator control is essentially a base load machine. Its limitations are readily apparent from the preceding paragraphs and are summarized as follows:

1. It must (when bleeding) always be operated in parallel with other units.
2. Its operating range is limited.
3. Its range decreases with high bleeder pressures.
4. In the small ratings, high bleeder pressures cannot be economically obtained.

Within these limitations, this system of bleeder control will be found to be both cheap and efficient. It offers possibilities which will repay careful study.

Figs. 2-4—Three ways to use a back-pressure regulator



TELEMETERING

Applications

Systems used in steam plant and waterworks practice are here described and the operation of three types is explained

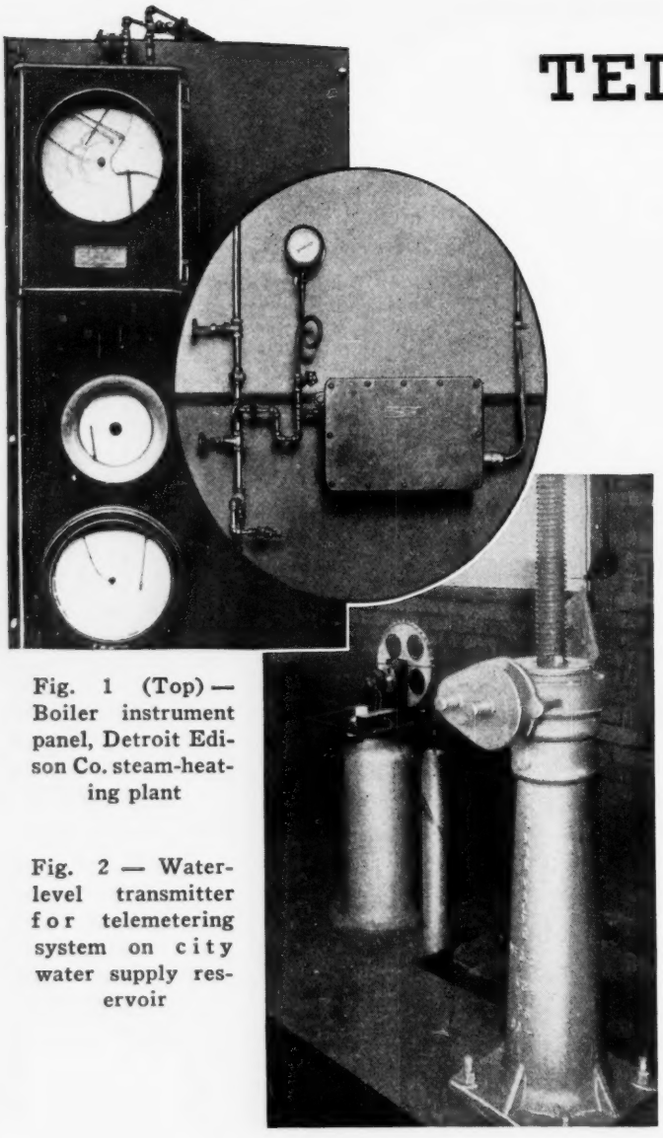


Fig. 1 (Top) — Boiler instrument panel, Detroit Edison Co. steam-heating plant

Fig. 2 — Water-level transmitter for telemetering system on city water supply reservoir

DURING the last ten years, telemetering systems have come into wide general use. Such a system may be defined briefly as "the indicating, recording or integrating of a variable at a distance by electrical means." The variable may be: rate of flow, pressure, temperature, liquid level, position, speed, voltage, current, power, or other factors.

Telemetering systems generally comprise three elements: the transmitter, which includes the measuring element; the receiver, consisting of indicating, recording and integrating instruments; and the connecting lines. The transmitter is located where the variable is measured, very often in an isolated spot not readily accessible, while the receiver is conveniently located for reading the instruments. Private wires or leased telephone lines may be used for connecting the two, depending upon the installation and type of equipment.

Telemetering Applications

Industrial plants and central power stations use telemeters for a wide variety of applications. In power plants, temperatures of condenser cooling water, feedwater, water in economizers, and pressures in boilers and at turbine throttle, are transmitted to the chief engineer's office. District steam-heating plants use telemeters to centralize at one location pressure readings taken at various points in the distribution system and of steam quantities supplied to consumers. Hydroelectric plant operators find records of distant-reservoir water levels valuable, as well as indications of gate openings. Telemetering is used with industrial processes to centralize in the superintendent's office measurements of factors vital to their functioning or to provide operators with a guide for regulating flow of fluids supplied to different parts of the plant.

Equipment

A boiler instrument panel in one of the steam-heating plants of the Detroit Edison Co. is shown in Fig. 1. At the lower left-hand corner of the panel, the meter records steam pressure in heating lines approximately 2,000 ft. from the plant. The oval insert shows the pressure transmitter mounted in a rectangular cast-iron watertight case suitable for manhole installations or other locations subjected to high temperatures and moisture.

Fig. 3 is a schematic diagram for connecting a Selsyn-operated receiver to the transmitter, as used on the system just described. Selsyns are essentially small motors which, when interconnected, operate so that one motor reproduces any motion imparted to the other. They are excited by alternating current at 110 volts of any commercial frequency. The three transmitter stator leads are connected to the three receiver stator leads and the rotor leads connected in parallel to the same excitation source. When an alternating voltage is impressed upon the rotors, if they are out of synchronism, their stator voltages become unbalanced and currents will flow in these windings. These currents produce a torque in both rotors which tends to bring them into phase. The transmitter rotor is held mechanically by the measuring mechanism, but the receiver rotor, being free to move, takes a position corresponding with that of the transmitter.

Normally five wires are required to make the electrical connections between the transmitting and receiving units. Three only may be used if the same electric

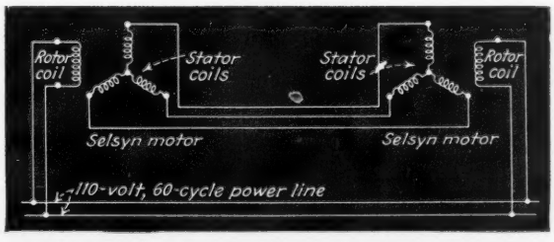
and Operation

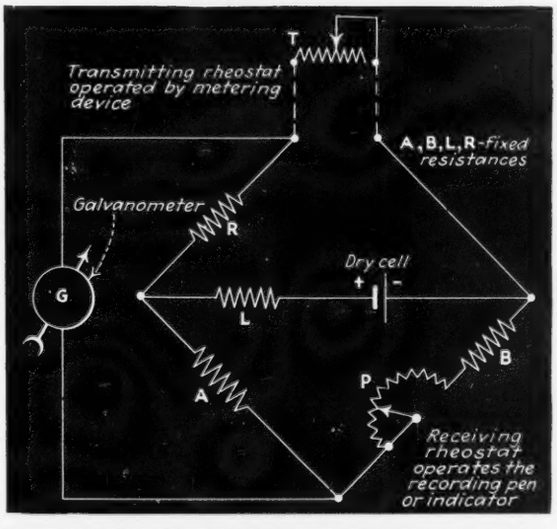
By L. D. Carlyon
Mechanical Engineer
Bailey Meter Co.

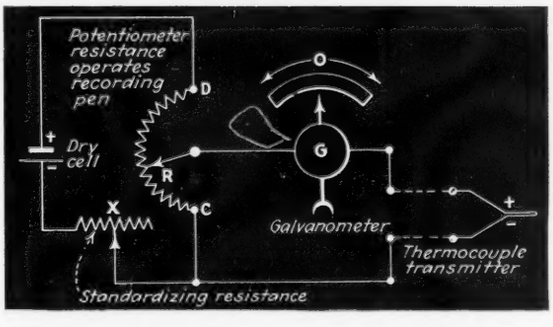
source is available at both locations to excite the rotors. Because of connecting-wire cost, Selsyn systems are normally used for services where the distance between transmitter and receiver is less than a mile.

Advantages of the Selsyn system are simple construction combined with ruggedness. This insures dependable operation over long periods of time without inspection even under severe operating conditions, such as excessive moisture and heat. One or more indicators or recorders, or both, may be operated from a single Selsyn transmitter.

Fig. 3 (Below)—Connection diagram of two Selsyn motors as used in telemetering system. Fig. 4 (Center)—Simplified diagram of a galvatron telemetering system. Fig. 5 (Bottom)—Simplified diagram of a potentiometer telemetering system







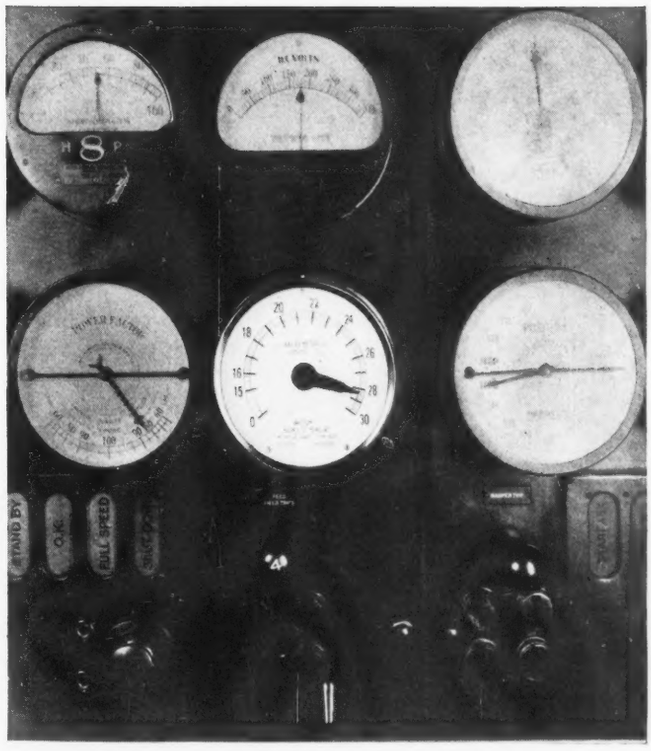


Fig. 6—Center meter lower row, telemetering vacuum indicator in Hell Gate plant

On the steam-distribution system of the steam-heating department, Cleveland Electric Illuminating Co., Selsyn telemeter receivers installed in the steam station show pressure at remote points in the system. One recorder enables the operators to maintain a predetermined steam pressure on the loop system for railway car heating. Another permits maintaining the desired pressure at the corner of Ontario St. and Prospect Ave.

Hell Gate Installation

A Selsyn vacuum-transmitting unit with a range of 0 to 30 in. of mercury is installed on a 160,000-kw. turbine in Hell Gate Station of United Electric Light & Power Co., New York. This unit is provided with an indicating scale and pointer to facilitate checking the indicating receiver, which is mounted on the turbine control panel shown in Fig. 6. The indicator has a suppressed scale from 0 to 15 in. of mercury to obtain a higher degree of accuracy and a more readable indication over the normal operating range.

For distances up to approximately 5 mi. a Galvatron type of telemetering with a Wheatstone bridge circuit is used. A float-operated transmitter with the cover removed, installed at the reservoir gate house of the City of Auburn, N. Y., for this type of system is shown in Fig. 2. A single-pen recording receiver is mounted in the pumping plant 3 mi. away to provide the operators with a continuous record of reservoir water level. Telephone wires are leased to provide the connecting

lines between the transmitting and receiving stations.

Fig. 4 is a simplified wiring diagram of the system. Resistance *T*, located in the transmitter, is varied by the measuring device according to the factor to be transmitted. The dotted lines represent lead wires between the transmitter and receiver.

Whenever resistance *T* is varied by a change in the measured factor, an unbalance of the Wheatstone bridge occurs which causes a deflection of the galvanometer. Periodically, the needle of the galvanometer is clamped to make an electrical contact of a length proportional to the deflection. This current is amplified through two vacuum-tube relays to operate a reversing electric motor. The motor positions the variable resistance *P* until the balance of the bridge is again restored. All movements of resistance *P* are transmitted through the cam to the pen of a recorder.

By using individual slide-wire resistances and reversing motors, as many as four records on one chart can be obtained with this system.

Total value of the lead-wire resistance for the circuit should not exceed 400 ohms. With lead resistance less than this value, changes in the resistance of the lead wires due to temperature variations have a negligible effect on the accuracy of the transmission.

Distances Over 4 Miles

For distances exceeding 4 or 5 mi., the Galvatron with potentiometer circuit is recommended. The measuring circuit for this equipment is given in simple form in Fig. 5. Variable resistance *X* may be adjusted to maintain a constant current flow through the slide-wire resistance *CD*. This establishes a fixed voltage between the ends of *CD* and, by means of the slider *R*, fractional portions of this voltage may be selected and applied to a circuit connected to the points *R* and *C*. When slider *R* is moved up the slide wire, the potential difference between *R* and *C* is increased. Therefore, if resistance *X* is carefully adjusted for a definite value of current, *CD* may be calibrated in terms of volts.

For temperature measurement, a thermocouple is connected from the transmitter to the points *R* and *C*. If voltage between *R* and *C* is equal and opposite to the thermocouple e.m.f., then no current flows through the thermocouple and the galvanometer will not be deflected. A change in thermocouple temperature will cause an unbalance of voltages, with a flow of current in one direction or the other and a proportional deflection of the galvanometer.

Vacuum Tube Relays

The galvanometer needle is periodically clamped to make an electrical contact of a period proportional to the galvanometer deflection and the current so produced is amplified through vacuum-tube relays to operate a reversing electric motor. This motor positions slider *R* until the galvanometer deflection is again zero. Motion of slider *R* is proportional to the thermocouple temperature and actuates the recording pen.

No currents flow through the thermocouple circuit when the galvanometer has been restored to neutral position. Therefore, any variation in resistance through themocouple lead wires, terminals, etc., will not cause inaccuracies in the temperature measurements. These characteristics combined with the use of a very sensitive current indicator results in a high degree of accuracy with the potentiometer type telemeter.

An auxiliary circuit, not shown in the diagram, contains a standard cell of constant voltage. This circuit is automatically connected to the potentiometer circuit at fixed periods, and automatically adjusts resistor *X* if required to standardize the circuit.

For measuring factors other than temperature, the thermocouple is replaced by a variable resistance actuated by the measuring device. In other respects, operation is the same as with the thermocouple.

WEEKEND HEATING STEAM CUT 75%

By John P. Topolosky
Steam Engineer,
St. Croix Paper Company

IN COLD climates, keeping manufacturing plants heated over weekends is a problem that involves considerable cost. This is especially so if weekend shutdowns extend over a period of two or three days, as they did in many plants during the business depression. At the St. Croix Paper Company plant, Woodland, Me. (see November *Power*, page 570), a plan of automatic building-heating control has cut weekend heating steam down to about 25% of that originally required. The system also gives automatic control over heating steam during periods of plant operation and has made a large saving in steam for this service.

Each department of the plant is heated by an indirect system comprising heating coils with a steam-turbine driven fan, the turbine exhausting into the heating coils. Steam to each turbine and heater is controlled by an electric hydraulically operated valve as in Fig. 2. Opening and closing of these valves are controlled by an automatic system shown diagramatically in Fig. 3. It comprises a master regulator and individual-heater regulator, one for each heating unit. The latter controls the electric-hydraulically operated valves on the heaters.

The 2-contact master regulator operates on outside temperature. Contact *H* is set to close when outside temperature is about 5 deg. or more above that when heat is required in the plant. Low-temperature contact *L* closes when outside temperature is below that when

some of the departments may require heating steam, say 60 deg. F.

When contact L closes because outside temperature drops below 60 deg., coil C is energized and closes contacts C_1 to put power on line L_1 and short-circuit contact L. The latter allows contact L to open, should the outside temperature rise slightly above 60 deg., without opening coil C circuit and causing the contactor to open. This contactor remains closed until outside temperature reaches a value that closes contacts H, which short circuits coil C. These contacts can be adjusted over a range of 50 to 80 deg. between closing and opening of contactor C. Normally the adjustment is set for contact L to close at 65 deg. and open at 67 deg. F.

Consider Heat From Process

Making line L_1 alive does not necessarily mean that heat will be turned on any department. This will depend upon the setting of the controller for, and the temperature of, each department. In the paper-machine room, heating steam may not be turned on all winter, because the heat from the process may be sufficient to do the heating.

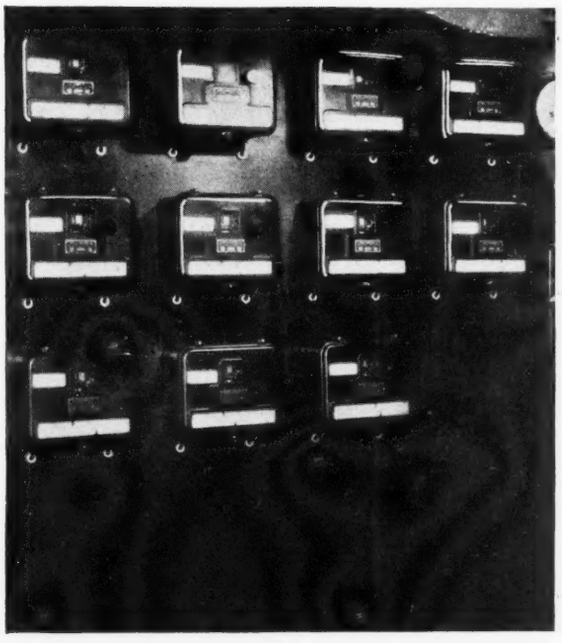
On the individual regulators, high-temperature contact H is set to open when the temperature drops to 2 deg. above that at which heat is required in a department, and low-temperature contact L closes when the temperature is 2 deg. below that value. For example, on No. 1 regulator, assume H is set to open at 62 deg. or less and L to close at 60 or below.

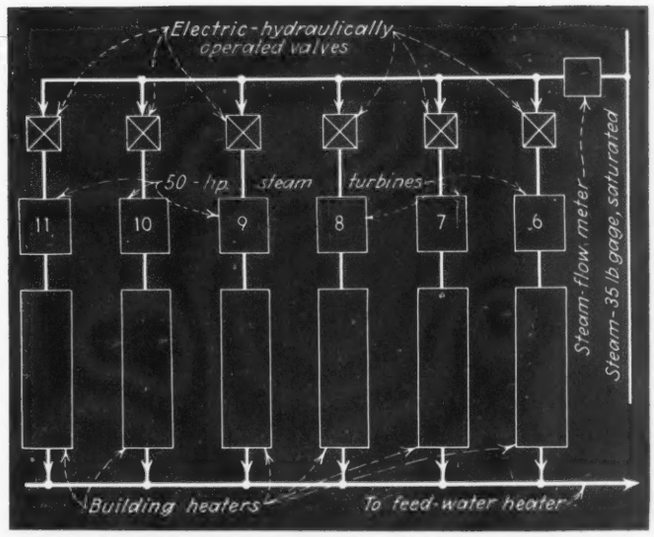
When contact L closes, it energizes coil C_2, and contacts C_3 close. The left-hand contact forms a holding circuit around contact L. The right-hand contact completes the secondary circuit of the transformer on the heating-valve control and closes contactor H_1. The latter energizes the valve-opening motor F, and the heating unit in that department is put into service. When temperature reaches 62 deg., contact H closes and short-circuits coil C_2, contacts C_3 open, shutting off the heating steam. Operation of the other controller is similar to No. 1. Only two of the control units are shown in the diagram, but there are 10, one for each department.

Over weekends, high-temperature contact H is set to open at 38 deg. and the low-temperature to close at 36 deg. to keep the temperature above freezing. As a result of this method of operation, no heating steam was required in the paper-machine room all last winter. Heating steam over weekends in cold weather has been reduced to about 25% of what it originally was. This reduction in heating steam has made possible supplying heating steam over weekends from the electric boiler, as will be described in another article.

All the heating controllers are mounted on a panel, Fig. 1, in the boiler room where the temperature-control adjustment can be conveniently made at the beginning of weekly and weekend operations.

Fig. 1—Assembly of the master and individual heating system regulators in the boiler room





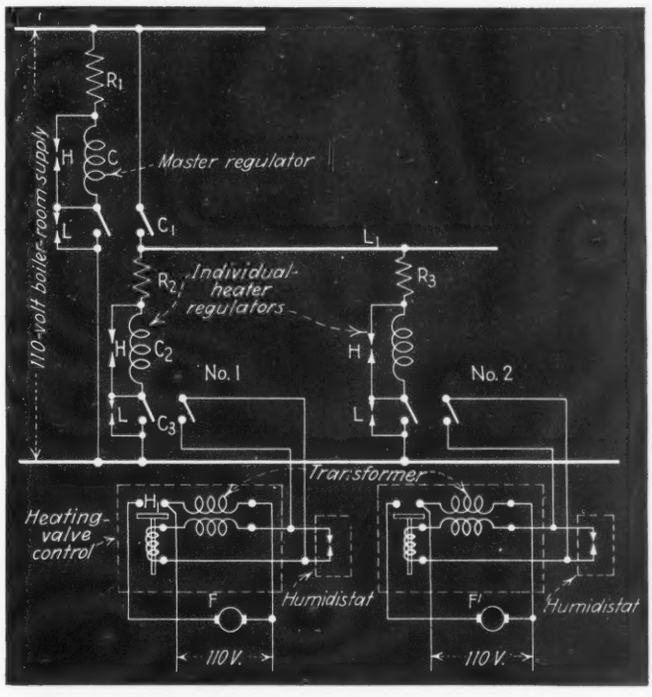
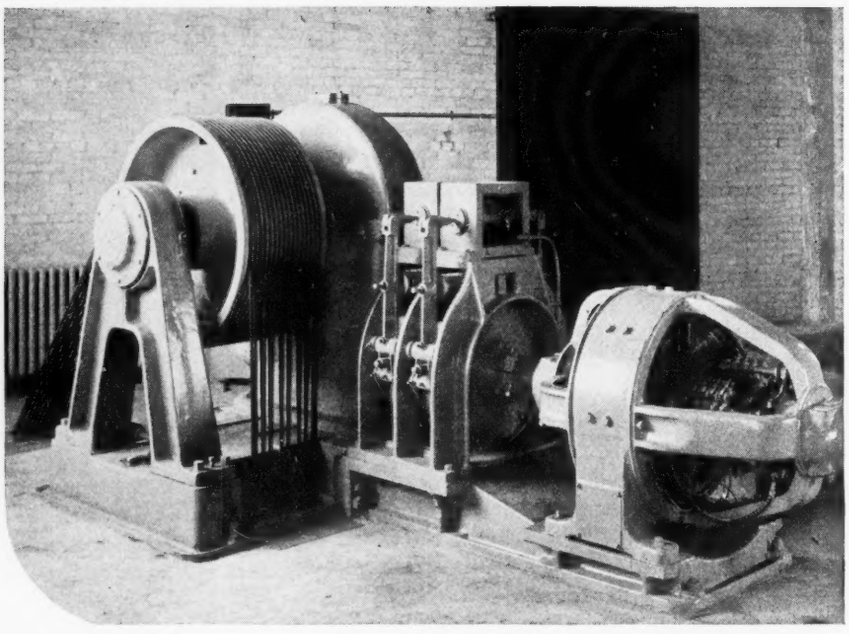


Fig. 2 (Top)—Diagram of heating units connected into the steam systems. Fig. 3—Diagram of heating-system automatic control



Heavy-duty geared traction elevator machine

By
C. C. Clymer and
R. F. Emerson
General Electric Co.
Industrial Engineering Dept.,

KNOW YOUR ROPES BY INSPECTION

FREQUENCY of hoist- or elevator-rope inspection depends a lot on the severity of service in which the equipment is used. Inspection at least once every three months where the equipment is subjected to what might be termed normal operation is recommended by at least one insurance company that insures machines of this type. In one plant the rule is to make an inspection once every month.

Inspection should include number of wires broken per strand lay, extent of corrosion, reduction in overall diameter, and how much the ropes wear the sheaves. Section 34, Bureau of Mines Bulletin No. 75 regarding rejection of hoisting ropes, reads:

"It shall be unlawful to use any rope or cable of the so-called 6x19 standard construction for the raising or lowering of men, either when the number of broken wires in one lay of said rope exceeds six, or when the wires on the crown of the strands are worn down to less than 65% of their original diameter, or when the superficial inspection provided for in this section shows marked signs of corrosion: provided, however, that when such broken wires are reduced by wear more than 30% in cross-section, the number of breaks in any lay shall not exceed 3."

By a lay is meant that length of a strand which makes a complete turn around the rope. It is our opinion that the above rule is amply conservative. Inspection of ropes for broken wires should be visual, and should be made with the hoist running at slow speed. Running ropes through cotton waste, or against a piece of wood, is not recommended. Frequently the broken wire ends remain sufficiently imbedded in the strands so that their presence can be detected only by a visual inspection.

Inspection for broken wires should also include a check for any evidences of rust or corrosion. Lubrication of ropes has often been recommended as a means of increasing their life, since this reduces internal friction caused by individual wires rubbing together. Care should be taken to keep ropes free from dirt. Grease will hold grit between the wires, and the resulting wear may be worse than if no lubrication were used.

Sometimes, too much lubrication starts ropes slipping on the sheaves, causing excessive wear on both. For lubricating the ropes, something like crater compound thinned out with a very light oil is recommended (Crater compound is a very viscous material with the general appearance of tar). This thinning process is necessary, as otherwise, it would be impossible to make a visual inspection of the ropes for broken wires. The crater-compound-oil mixture protects the ropes against corrosion and will not cause them to slide over the head sheaves due to excessive lubrication. This lubricant has been used successfully on mine hoist ropes when moisture contained corrosive sulphur compounds. A less viscous oil might be used successfully, but would require more frequent applications.

If ropes do not give the life expected of them, considerable improvement can be obtained by increasing sheave diameters and avoiding reverse bends as much as possible. By a reverse bend is meant bending a rope over a sheave in one direction, after it has bent over another sheave in the opposite direction. The effect on rope life is much worse if each succeeding bend is a reverse bend than if all the bends are in the same direction.

A good rule to follow for hoist and elevator service is not to use sheaves of diameters less than 58 times

that of the rope, assuming standard 6x19 rope is used. For example, a $\frac{5}{8}$-in. diameter rope should not be used on sheaves less than 36 in. in diameter. This ratio may seem conservative compared with other recommendations of around 40 to 1. The hoist distance and severity of service has a lot to do with this rule.

Some elevators in the Empire State Building, New York, require a mile of rope. Obviously, it is good judgment to be conservative in sheave diameters on a job like that, because it would be expensive to have to change these ropes very often. On mine hoists, where ropes are sometimes thousands of feet long, sheave diameters of 70 to 90 times rope diameter are used. This extra expense for large-diameter sheaves pays good dividends to the owner.

The question of relative hardness of ropes and sheaves also has an important bearing on rope life. For hoists requiring long ropes, wire that is very hard and also sufficiently ductile so as not to crystallize, is the ideal type. However, such ropes may wear sheave grooves. The resulting pinching action on the ropes in the tight grooves may cause them to wear rapidly.

Too much lubrication caused slipping of the ropes over the traction sheaves of some elevators in a bank building. Dry ropes were substituted and operated successfully with the single exception that they scored the sheaves. Applying a rope dressing, using crater compound as a base, completely overcame this tendency.

The rope dressing was made by mixing just enough light mineral oil with the crater compound to permit its application with any ordinary paint brush.

These ropes, in spite of the fact that they were made with no internal lubrication, operated for over 56,000 miles on a 2,500-lb., 800-f.p.m. elevator in local service. Such service subjects ropes to rapid bending stresses and frequent high stresses in tension during acceleration and retardation. They were $\frac{5}{8}$ in. in diameter and operated over 36-in. sheaves on a conventional double-wrap traction-elevator machine.

Factors in Rope Life

It is sometimes difficult to determine just why ropes on one installation wear out so quickly, or why on another they last so long. In one plant there are two buildings of the same height, having elevators operating under identical conditions of service, using ropes of the same size. A recent inspection of the ropes on one elevator, after eight years of service, indicated that they are good for several years longer. This elevator has 8x19 Seale construction ropes. The other elevator has 6x19 ropes, and the last inspection showed as many as 12 wires broken in one foot of a single strand, indicating that they should be changed.

It might be expected that 8x19 ropes should not last as long as 6x19, because greater flexibility is usually gained at a sacrifice in strength by using smaller-diameter wires. In this case, other factors evidently had a greater effect on the wearing qualities of ropes than size of individual wires.

Ropes may be operated with a factor of safety of 15 or more. Consequently, other factors besides stresses occasioned by the normal load on them may have a much greater effect on their life than might be expected.

MONEY for POWER

WHILE various surveys made by business institutions and trade papers show the general obsolescence of machinery and equipment in factories, industrial and manufacturing plants, perhaps the greatest single need along these lines lies in power- and heat-producing facilities. At least, this is the experience of representatives of the Federal Housing Administration, who have been visiting concerns which have been making structural and equipment improvements financed through the facilities offered by the provisions of the National Housing Act and its amendments.

Approximately 45% of the firms interviewed have installed new steam boilers and improved facilities for heating or power, or both. And in each instance it is believed that the economies in fuel or greater efficiency will more than pay for the installations.

Under the National Housing Act as amended, modernization credit funds up to $50,000 are available from private financial institutions to factories, industrial and manufacturing concerns, hotels, multiple apartment houses, colleges, schools and owners and operators of other properties for installation of heating and power systems and structural improvements, repairs and alterations. The Federal Housing Administration does not lend money. It insures commercial banks, trust companies, building and loan associations and other private financial institutions against loss on credit extended for modernization work. Full details are available from any FHA office or from a qualified lender. Major data appeared in August, 1934, *Power,* and reprints are available for anyone interested.

Manufacturers, engineers and contractors are urged to submit their catalogues and descriptive literature, with photographs, if possible, to the Federal Housing Administration for rulings on eligibility of equipment and machinery for government-insured financing.

A booklet, "Equipment and Machinery Eligible for Modernization Credit," published by the Federal Housing Administration, contains a resume of the Housing Act as amended as well as the latest list of approved items. This information may be had by writing to Washington, D. C., or applying to any of the state or regional offices of the Administration.

Among the general principles which govern the Administration's determination of eligibility for equipment and machinery are that the article should have a unit value sufficient to justify the application of time payments to its purchase and that it should be of a durable nature with a reasonable expectancy of a useful life longer than the term of credit for its payment.

Loans for purchase and installation of replacement parts for eligible machinery and equipment are insurable, but a loan merely for the repair of a machine is not. Appurtenances which are physically separate from a major eligible unit, but usable only as a part of such unit, are themselves eligible. However, an item, ineligible because of some disqualifying characteristic, does not become eligible because it can be used with an eligible item or is bought therewith.

TEST YOUR OWN BOILERS—VII

By Walter H. Wood
Combustion Engineering Co., Inc.

THE rate of burning fuel, and the amount of fuel in the furnace, should be as nearly as possible the same at the beginning and at the end of a test. If the rate of feeding fuel to the furnace, or fuel-bed thickness, is less at the end of a test than at the start, apparent results will be better than they actually should be. On the other hand, if there is more fuel on the grate, or if the rate of feeding of fuel is greater, at the end than at the beginning of the test, actual results will be better than the figures indicate.

When oil or gas is burned, the rate of feed of fuel should be noted for some time before beginning the test, and the flow set at the same rate a similar time before the test ends. When a solid fuel is burned, the fire should be cleaned before the test is started, and again before the test is finished. Time of cleaning the fire before starting the test should be recorded, along with any other general notes that are to be made during the test. At the end of the test, the fire should be cleaned far enough before the finish so that about the same amount of fuel will be burned between the cleaning and the end of the test as was burned between the first cleaning and the start of the test. Just as at the time of starting, thickness and condition of fire should be determined and noted.

In the case of hand-fired furnaces, the fire should be allowed to burn until enough of the flame and smoke have disappeared so the fuel bed is easily seen. The fire should be leveled with a hoe, and a moment or two afterward an observer should sight across the top of the fuel bed and estimate its thickness. It is a good plan to put a chalk mark on the furnace door frame at the height of the surface of the fuel. Distance of the mark above the dead plate should be measured or estimated, and noted. A record should then be made of the condition of the fire, as for example, "coked, ready for slicing," or "well burned, ready to be covered," etc. A better start and finish can be made with a thin, well-burned fire than with a thick, smoky fire.

Fuel beds on stokers can be examined in the same way if there are doors in the front of the furnace near the level of the grate. If the load on a stoker-fired boiler will permit, stoker speed, fire thickness and air supply should all be noted and kept about constant for at least half an hour before actually starting and also before finishing a test.

Solid Fuel

If coal or other solid fuel is burned, the fire must be cleaned at least once during the test. A short test, made without cleaning the fire, would not represent actual operating conditions. Such intermediate cleanings as may be necessary to carry the load must be made and the time of making those cleanings noted. The test can be ended when the fire is in the proper condition following the last of these cleanings. It is often impossible to determine in advance just how long a test is to be run. If there is little ash in the fuel and the rating is low, the time between cleanings may be rather long, say six hours. Making an intermediate cleaning 6 hr. after the initial cleaning before starting the test would mean that the test should run twelve hours, with a final cleaning just before the finish. An 8-hr. test made under such conditions would require a cleaning about 2 hrs. after the intermediate cleaning. There would not be much ash on the grate, and the condition of the fire would not warrant cleaning. If it were made, the results would not be as good as should be expected. In such a case, it would be better to make an intermediate and a final cleaning about 5 hr. apart. The test would then be approximately 10 hr. long.

Fires on stokers of the dump type should be cleaned long enough ahead of the time set for starting, to enable the fuel bed to be put in good operating condition. Before time for ending the test, the fire should be cleaned and the fuel bed brought back to the same condition. The test should not be continued beyond the time when the condition of the fire following the final cleaning is the same as it was when the test was started. In making a test of a stoker of the clinker-grinder type, the pit should be lowered to a suitable level a short time before the beginning, and a like time before the end of the test. The time of grinding should also be noted.

In making tests of any furnaces of the forced-draft type, the supply of air for burning the fuel should not be cut off near the finish of the test. By cutting off the air supply, the rate of steam generation and release in the tubes and drums falls off, causing water level in the gage glass to drop. If the feed pump is speeded up to raise the water level, an undue amount of water will be fed to the boiler.

Water from feedwater heaters is usually too hot to be weighed or measured without difficulty, consequently cold water is generally used. Change of feed from hot to cold water makes a difference in the rate of steaming. For that reason, cold water should be fed for several minutes before starting the test. 10 or 15 min. before time to start the test, both of the measuring or weighing tanks should be filled. The discharge valve on one of these tanks should be opened and the lower or suction tank filled. The test pump should be started, and as the water is drawn from the suction tank, addi-

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tional water should be supplied by running through the one measuring tank. The other measuring tank should be kept full. Water in the suction tank should be held at a fixed level until the test starts.

At the exact time of starting the test, the discharge valve on the measuring tank should be closed and that tank filled to the proper level. As it is being filled, the discharge valve on the full measuring tank is opened to supply water as it is taken by the feed pump. When that tank is entirely empty, the time should be noted and recorded, because that amount of water has gone to the boiler in the time elapsed between the start of the test and the complete emptying of the measuring tank. By the time one tank is empty, the other should be full and ready for use. The discharge valve on the second tank is opened, and that on the second tank closed, and the process continued.

To avoid confusion as to the number of tanks of of water used, it is best not to make a record of a tank of water until that tank is completely empty and its discharge valve closed. At the finish of the test, it is advisable to continue running the feed pump and recording the tanks of water, until one tankful has been emptied after the close of the test. If one tank was not emptied at exactly the time the test ended, the part of that tankful which should be credited to the test can be calculated. Suppose that the test ended at 6:15, and that a tank was empty at 6:11. By continuing to pump water to the boiler at the same rate after 6:15 the next tank might be empty at 6:18, or 7 min. after the previous tank was empty. If this tank held 1,240 lb. of water, the rate of feeding water to the boiler was $\frac{1,240}{7}$ = approximately 177 lb. per min. In the 4 min. from 6:11 to 6:15 when the test ended, $4 \times 177 = 708$ lb. had been used from the last tank, and that amount should be the final quantity shown on the feedwater record.

The height of water in the gage glass may not be exactly the same at the conclusion as at the beginning of a test. It is better to calculate the amount of water represented by a small difference of level than to try to bring the water to the proper level in a short time. The pump should not be speeded up unduly just before the end of the test to bring the water up, nor stopped to drop the height of the water. Speed of the feed pump should be watched for 15 min. or longer before the test is ended, to hold the level of water as near to the starting point as possible.

63 YEARS AN ENGINEER

BORN in 1848, at Greenwich, R. I., Charles W. Smith, 125 Florence St., Boston, Mass., is establishing a remarkable record as a steam-plant engineer. Although Mr. Smith will be 88 years old on his next birthday, he may be found on duty each day at the boiler plant where he has had charge for the past 55 years.

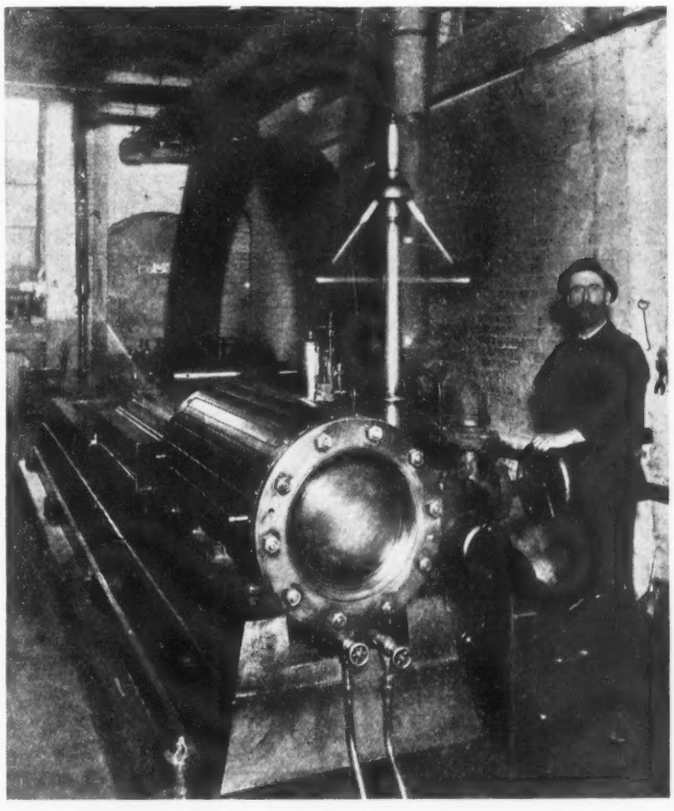
Mr. Smith spent his first three years in the engineering field at the old Ludlow Twine Factory in East Braintree, Mass., where he worked as fireman and engineer from 1873 to 1876. Here he had charge of four Cunningham 2-flue boilers operating at 70 lb. per sq.in., a very high pressure for that time. Line-shafts were driven in this mill by two 150-hp. Corliss engines.

In 1876, Mr. Smith left to take charge of one of the early Cunningham horizontal-tubular type boilers at the Fancy Woodworking Factory, Weymouth, Mass. A 40-hp. Corliss engine operated at 70 lb. pressure.

Since Dec. 7, 1880, Mr. Smith has been constantly in charge as chief engineer of the boiler plant of a large mercantile building owned by the estate of James M. Beebe at 250-280 Dover St., Boston, Mass. The picture was taken as he stood beside an old 90-hp. engine some years ago. This engine was a mongrel assembly of Putnam, Green, and other parts, and it has been removed recently. Present equipment includes two horizontal-tubular boilers generating steam for heating and manufacturing process work. The boiler plant is spotless and is a fine example of care in maintaining a neat and well-kept boiler room.

One would expect that in the length of service Mr. Smith has seen, a number of accidents or emergencies would have arisen. Elimination of all carelessness from his plant operation has established a record of 63 years without an accident in any plant under his charge. A record equally remarkable is that with the exception of a few weeks of recuperation from a recent illness, he has not lost more than several days' time in these 63 years as an engineer.

Mr. Smith's father served as an engineer for many years before him, and his son is now his assistant.



CONTROLS COORDINATE THE AIR-CONDITIONING

EVEN though equipment of proper type, quality and capacity may be assembled for the job of conditioning air, satisfactory performance cannot be expected unless controls are provided. These controls must be capable of adjusting the capacity of the system, which is designed for maximum conditions, to the widely varying intermediate temperatures and humidities that occur 90% of the year. Such control not only prevents waste of refrigeration and heat but also prevents temperature fluctuations and discomfort from over-heating and under-cooling. Too much cooling in summer may create more discomfort and ill health than no air conditioning at all. For comfort conditioning, the difference between indoor and outdoor effective temperatures should not be more than those shown in the table. Where complete air conditioning is installed the controls must take care of both winter and summer conditions. Thus for winter, controls must be provided that will turn steam on and off to heating coils. For summer, temperatures of the air-washer spray or cooling coils must be adjusted to give the required humidity and dampers then operated to control the amount of air by passed, amount of fresh air intake and return air exhausted.

Primary Control Elements

The primary elements of control are thermostats which are sensitive to dry-bulb temperatures, humidistats which are sensitive to relative humidity or combination dry- and wet-bulb thermostats. These primary elements control temperature and humidity separately. There are combinations available which are arranged to maintain a desired effective temperature. In these, dry-bulb temperature setting is varied automatically to suit the relative humidity existing at the moment. If humidity rises, the dry-bulb temperature is automatically lowered in correct ratio to maintain unchanged the desired effective temperature. These primary instruments may operate valves and damper motors either electrically or by compressed air. They may be either quick-acting (in which case the controlled valve or damper is either wide open or closed), or gradual-acting (in which case the controlled valve or damper may be held in any partly open position required by conditions).

In general, electric control is used for small installations, and either air or electric used for larger installations. It is dewpoint temperature that determines the amount of moisture in the air, thus in air-conditioning systems employing air washers the desired humidity is obtained by controlling the temperature of the spray water (which determines the dewpoint temperature). If the temperature of the spray water is regulated so that air leaves with a dewpoint of say 45 deg. it will have a relative humidity of 40% when heated to a room temperature of 70 deg. Thus, to control humidity, a gradual-acting thermostat is often placed at the exit of the air washer and arranged to control a valve which admits refrigerated water to the suction of the spray-water pump when exit-air temperature rises above the required dewpoint. A humidistat which responds directly to changes in humidity may be used to control dewpoint instead of the thermostat at the air-washer exit. The humidistat is, however, placed in the conditioned room or in the path of the return air leaving the room. A combination wet-bulb and dry-bulb thermostat may also be used in the same location as the humidistat.

With usual room conditions, saturated air will have a relative humidity of approximately 50% when its temperature is raised 20 deg. Thus, a differential thermostat consisting of one element in the path of the air leaving the air washer and the other in the room can be made to maintain a nearly constant relative humidity by keeping the dewpoint temperature 20 deg. below room dry-bulb temperature.

When relative humidity is controlled with air washers, the air usually must be reheated before it can be supplied to the conditioned space. This may be done with return air bypassed around the air washer, or by reheating with steam coils, or both. When bypassing is used, a gradual-acting thermostat is usually placed in the duct after the supply fan and arranged to open bypass dampers and close recirculation dampers when the temperature falls below the thermostat setting. If reheating coils are used, a 1- or 2-point quick-acting thermostat should be used to open steam valves to reheat coils.

Winter Operation

For winter operation, quick-acting thermostats are installed to control valves supplying steam to tempering coils in the fresh-air inlet. Various arrangements may be employed here, but in most of them a thermostat is arranged to open the valve to the first tempering coil when outdoor air falls below about 35 deg. As outdoor temperature decreases, additional tempering coils are put in operation either by the thermostat or humidistat used to control humidity, or by a thermostat at the air-washer inlet if spray water is heated.

It should be noted that when a central air-conditioning system serves several rooms having different rates of heat gain or loss, different room temperatures will

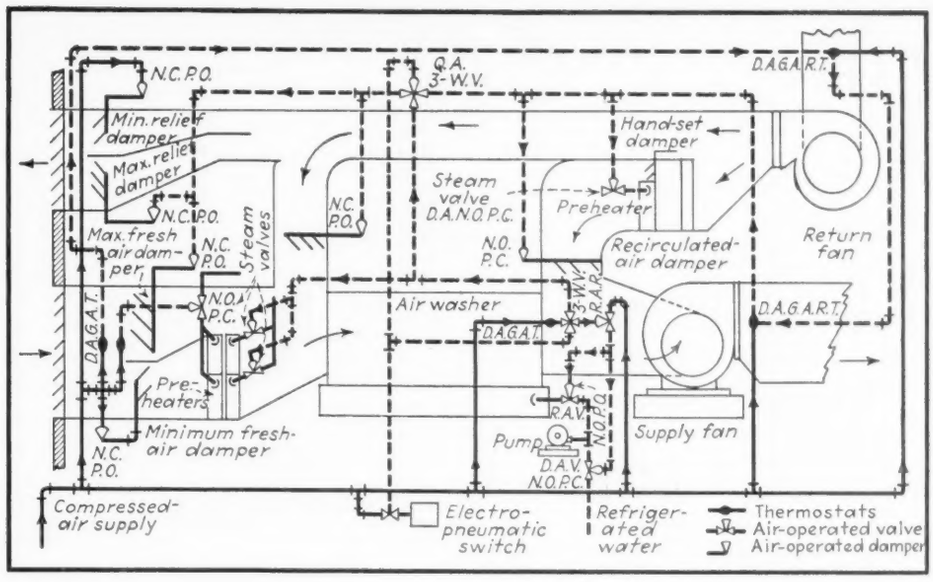
DESIRABLE INDOOR CONDITIONS

Outdoor Temp. Deg. F.	Indoor Air Conditions Dew Point Constant at 57 deg. Dry Bulb	Wet Bulb
95	80.0	65.0
90	78.0	64.5
85	76.5	64.0
80	75.0	63.5
75	73.5	63.0

From A.S.H.V.E. Guide.

SYSTEM

By R. B. Purdy
Associate Editor



Air-operated control for a central air - conditioning system

LEGEND

	Instruments	Controlled Units
D.A.—Direct-acting	Passes increasing pressure on rising temperature	Pressure closes (normally open)
R.A.—Reverse-acting	Passes decreasing pressure on rising temperature	Pressure opens (normally closed)

N.O.—Normally open—Open at no pressure
N.C.—Normally closed—Closed at no pressure
P.O.—Pressure opens
P.C.—Pressure closes
Q.A.—Quick-acting
G.A.—Gradual-acting
T.—Thermostat
R.T.—Reset thermostat (a thermostat which has its control temperature shifted automatically)
3-W.V.—3-way valve
Thus: D.A., G.A., R.T. means direct-acting, gradual-acting, reset thermostat.

result unless volume of conditioned-air supply is controlled, or individual heaters or coolers are provided to make up the difference. Similarly, if water-vapor gain or loss varies in the conditioned spaces, different relative humidities will result unless independent humidification or dehumidification is provided. This is particularly important to consider in industrial air conditioning because of the varying amounts of heat and moisture gain in various factory departments.

The illustration[1] is a diagram of an actual pneumatic control system. During winter operation, the return-air thermostat controls, through the thermostat in the supply-fan discharge, the reheater and recirculation air damper. The dewpoint thermostat in the discharge from the air washer controls the return-air damper and inside row of preheaters. The quick-acting thermostat in the fresh-air intake controls the outside or first row of preheaters.

In summer, when the refrigeration compressor is started, the electric-pneumatic switch operates to change over the two 3-way valves for summer operation of the controls. The gradual-acting thermostat in the fresh-air duct comes into operation when the outdoor temperature reaches 70 deg. to reset the return-air thermostat 1 deg. for each 2½ deg. change in outdoor temperature. The return-air thermostat resets the fan-discharge thermostat in inverse ratio an amount determined by design. This arrangement tends to stabilize the control and prevents over-cooling. The fan-discharge thermostat controls the recirculated air (air-washer bypass) damper and return-air damper in opposite directions. The dewpoint thermostat controls the supply of chilled and recirculated water to the air-washer sprays through opposite-gradual-acting valves. The electric-pneumatic switch through the 3-way pilot valve permits the dew-point thermostat to control the spray-water valves only when refrigeration is on. It also causes the maximum fresh-air and exhaust dampers to be kept out of control, therefore closed, when refrigeration is used. This arrangement permits evaporative cooling to take place whenever permitted by a low enough outdoor wet-bulb temperature, thus conserving refrigeration.

Two vital matters in air-conditioning control are excessive hunting, which should be avoided, and thermal lag, for which compensation must be provided. Lag is due to the time element in the air cycle between the element controlled (such as spray water or reheater) and the sensitive control element (such as a thermostat), and the heat absorption or yield to or from the materials of the air-conditioning system. Clever adjustment built into the instruments help to overcome these difficulties.

When coils using direct expansion of a refrigerant are used in the air stream for cooling instead of an air washer, there are several alternate methods of control all of which are in use:

1. Automatic control of air volume through and by-passing the coil.
2. Automatic cut-out of coil sections with coils either in parallel or in series.
3. Subdivision of refrigeration capacity with two or more units under automatic control.
4. On and off control of a single unit by dry-bulb room thermostat.

It is usually the controls which are cut out when buyers trim first costs, whereas proper controls have so much more to give in satisfaction and lower operating costs in comparison with other possible savings in first cost.

[1]Furnished by A. W. Canney.

SPEAKING OF POWER

● Things are popping fast these days in the field of boiler feedwater treatment. Professor Straub, for example, startled the recent annual meeting of the A.S.M.E. by reversing his previous conclusion that pure sodium-hydroxide solution will cause cracking of boiler metal under stress. Traces of impurities (notably sodium silicate) in his earlier test reagents apparently made it possible for the hydroxide to do its dirty work. Shades of old "caustic-embrittlement" arguments will fidget in their graves while the chemical hounds trail the new scent. Meanwhile operators will remember that hydroxide is as dangerous as ever, because the vital impurity found in the test reagent is also generally present in the boiler water.

Our old friend, Alfred Vaksdal, plant engineer of Corning Glass Works and welcome *Power* contributor, finds himself in the public eye again. Last time it was in connection with the floods that endangered power and control equipment serving the anneal of the 200-in. telescope mirror casting. Now we gather from the newspapers that Al is busy with a new plant Corning is putting up to spin and weave glass wool into silky, fireproof fabrics. . . . His spare moments (if any) are still devoted to cutting power-service costs.

Giving credit where credit is due, we must admit that America is trailing England in smoke elimination. . . . Don't misunderstand me to imply that London and other British cities are spotless towns. Tens of thousands of soft-coal domestic grates make that impossible. What I do mean is that London is air-conditioning her big power stacks with a vengeance. . . . Battersea, for example, runs every bit of flue gas through an enormous laundry that that uses 20 tons of water for every ton of coal burned. Eliminations claimed are: sulphur compounds, 97 to 99%; dust, 97 to 98%; nitrogen oxide, 60 to 70%; hydrochloric acid, 90 to 93%. . . . While we argue here about what "smoke" is, our Transatlantic brethren settle the matter by deciding that it is everything you shouldn't breathe or look at. Eventually America must arrive at the same conclusion, but it will take time, courage and more money than we like to think about.

Another feather in England's cap is the recent starting up of the world's first commercial plant for turning bituminous coal into gasoline by "hydrogenation." Treated with hydrogen at high pressure and temperature, coal yields 50 to 70% its own weight in gasoline.

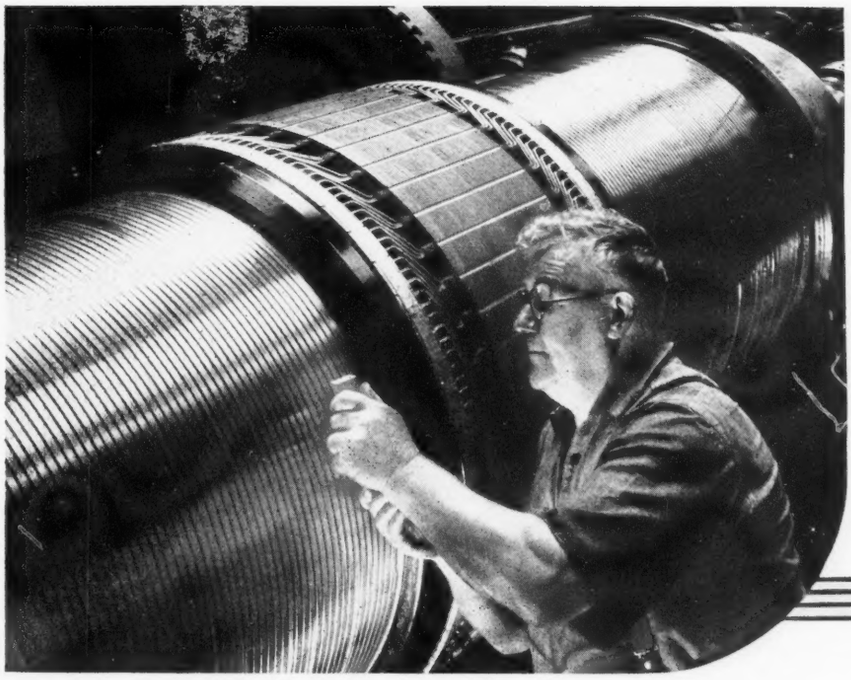
National use of electricity moves up and up. During the first three weeks of December, utility output averaged 1,985,000,000 kw.-hr. weekly, 8 to 9% higher than the figures for the same period of 1929. . . . In my opinion the reasons are obvious: steadily lowering rates in many parts of the country, growing public and industrial interest in juice-consuming machines and gadgets, constant improvement in general business conditions. . . . Nearly a year ago *Power* stated that the further expansion of utility generating capacity could not be far away. This prediction was questioned by some, partly on the ground that the utilities were in no mood to invest money because of government interference in power matters. We could not see then, and cannot now, how this undeniable situation can appreciably retard the factors that build load. . . . And who can believe that the consumer will some day bring up the bucket and find the kilowatt well run dry?

Here's an interesting slant on power costs from David Moffat Myers' new book, "Reducing Industrial Power Costs." . . . In the boom year of 1929 the manufacturing industries paid $3,567,000,000 cash and stock dividends and spent (U. S. Census) $1,973,000,000 for fuel and purchased electricity. This was 55% of the dividends. Adding no fixed charges and too little for labor, supplies, maintenance and repairs, we find that 60% of dividends is a conservative estimate of industrial power and heat operating cost in a boom year. In lean years this percentage easily rises to 100, and when this occurs a 20% cut in this cost makes possible a 20% increase in dividends. . . . Even in 1929 a 20% saving could have increased dividends 12%. Certainly this is something for power engineers and management to think over and talk over.

Pressure of year-end publications and meetings has tied me too much to the New York atmosphere in recent weeks; the benign influence of a lot of traveling in 1935 is wearing thin. So I hope soon to pack the bag and hit out for distant parts to talk with power engineers on their jobs and see first-hand what is going on. . . . A little later I hope to have something interesting to report along this line.

"The bright ideas of today are the specifications of tomorrow." . . . I forgot where I saw this, but it's sound, as long as we remember that not every bright idea by a long shot becomes a specification, although every specification is the outgrowth of bright ideas. . . . Let me list a few "hair-brained" schemes that became standard: steam-operated pin wheel (turbine), igniting power fuel by compression heat (diesel), binary cycle (mercury-steam plant), bleeder heating of feedwater, electrostatic precipitation of flue dust, pulverized coal, hydraulic ash removal, welding boiler drums, using X-rays and gamma rays to reveal defects in metal.

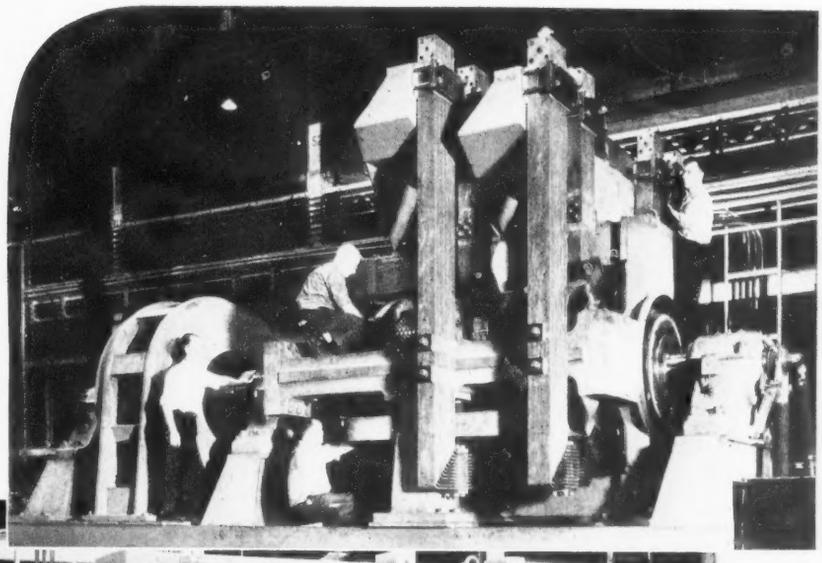
PHIL SWAIN
Editor

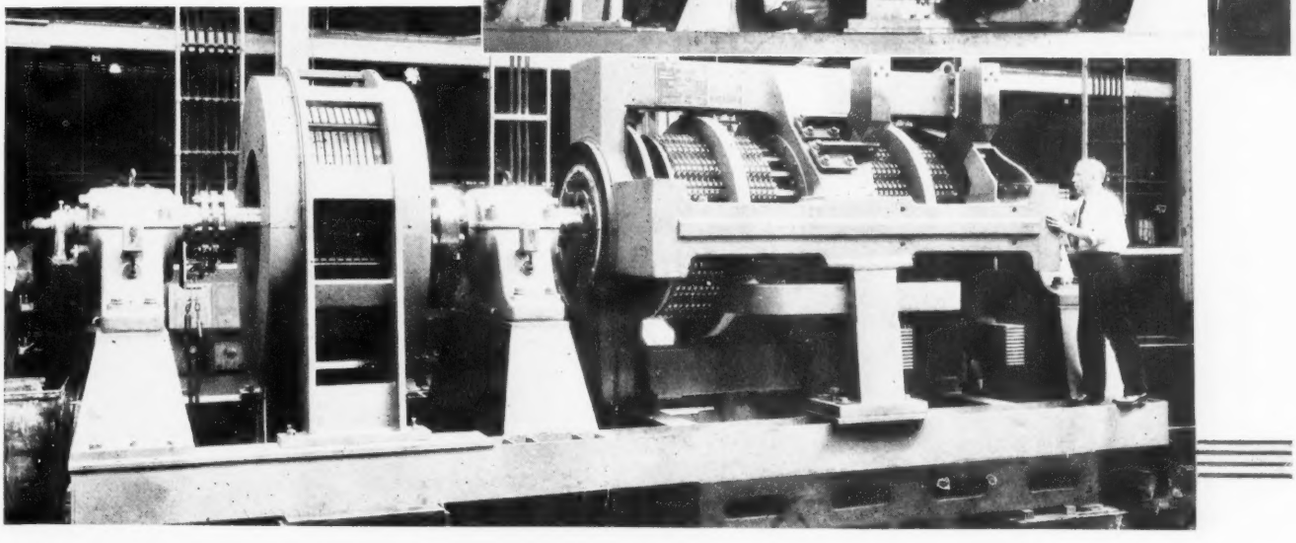


Celebrating its 50th anniversary this year, Westinghouse has built a homopolar, or commutatorless, generator which generates the largest flood of direct current yet produced

COMMUTATORLESS D. C.

For industrial use, this 150,000-amp., 7½-volt machine is driven by a 514-r.p.m. synchronous motor. Specially humidified air is furnished the 1,400 brushes which collect current from two spirally grooved collectors, shown above

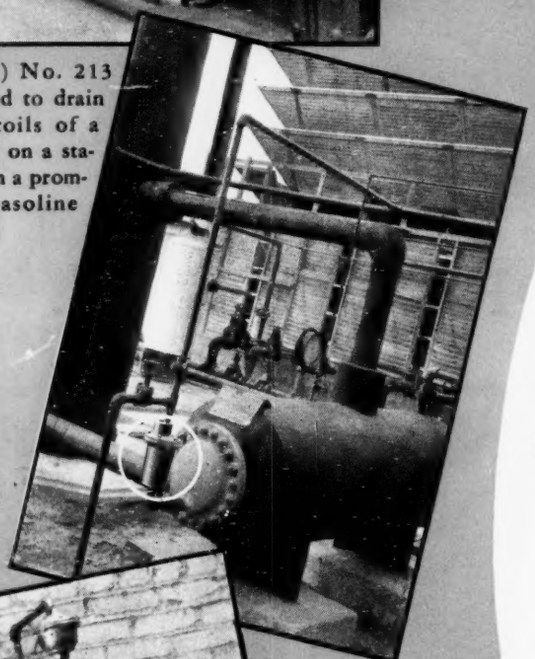


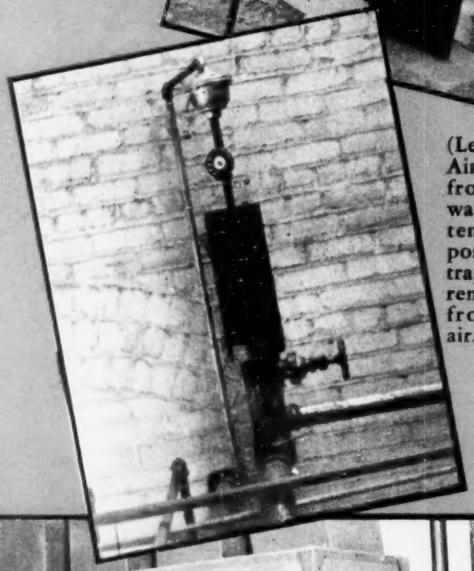


A TRAP FOR

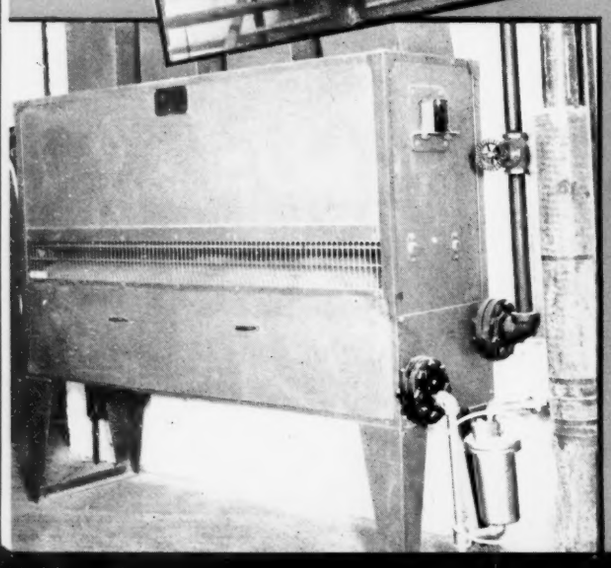
(Left) Individual No. 200 traps draining cylinder sizing machine in textile industry. This is the smallest Armstrong trap. Where right angle pipe connections are desired, ask for No. 201.

(Right) No. 213 trap used to drain steam coils of a reboiler on a stabilizer in a prominent gasoline refinery.

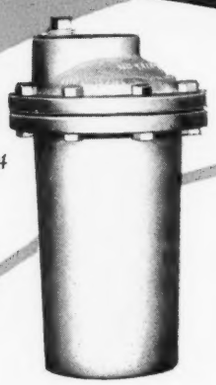




(Left) This No. 21 Air Trap vents air from a closed hot water heating system. In inverted position the same trap can be used to remove condensate from compressed air.



(Left) Here is a No. 214 trap installed on a heavy duty unit heater in a prominent food products plant.



No. 214

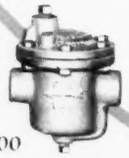
No. 213

No. 212

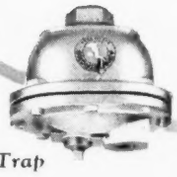
The Line

No. 211

No. 201



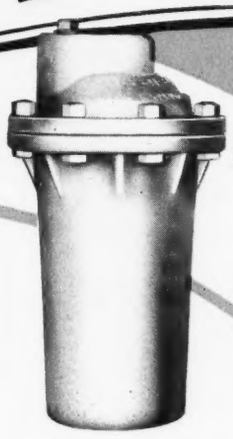
No. 200



No. 21 Air Trap

ARMSTRONG
812 MAPLE STREET

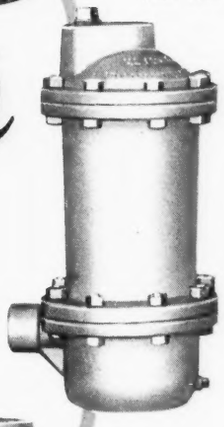
EVERY PURPOSE



No. 215

No. 216

is Complete



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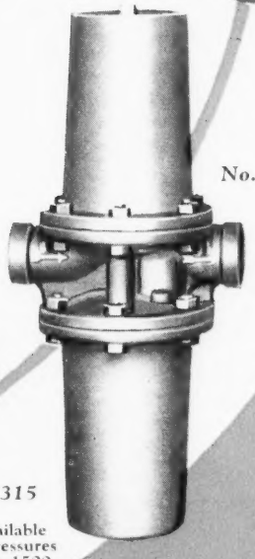

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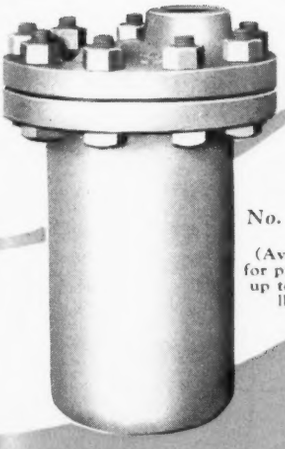
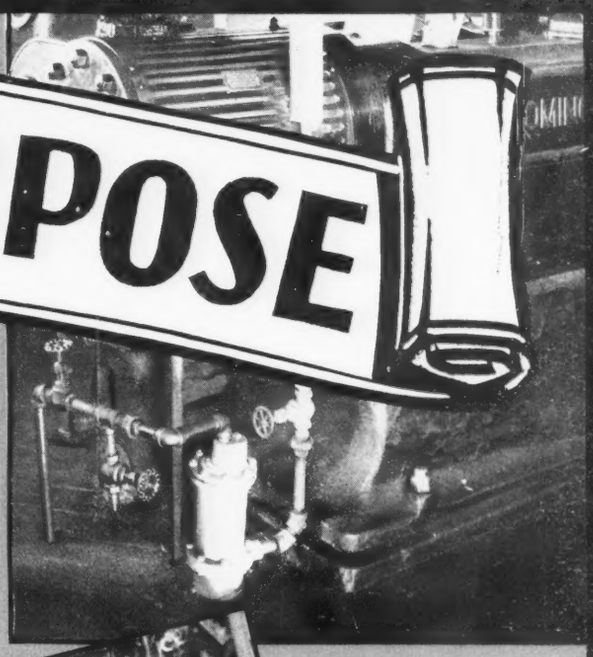
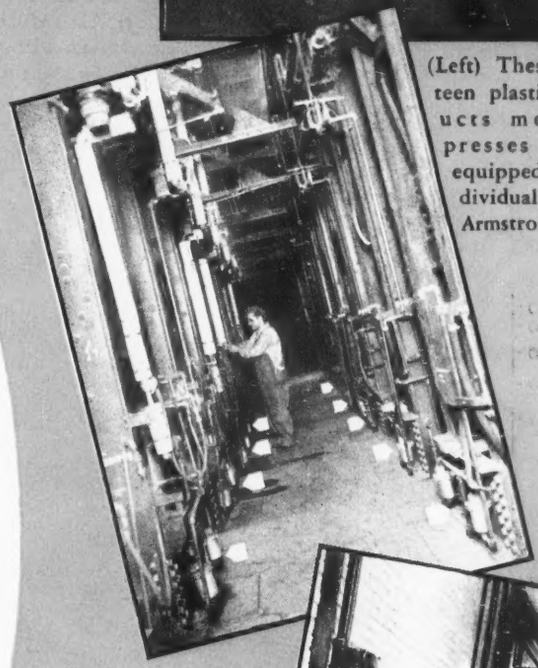


No. 315

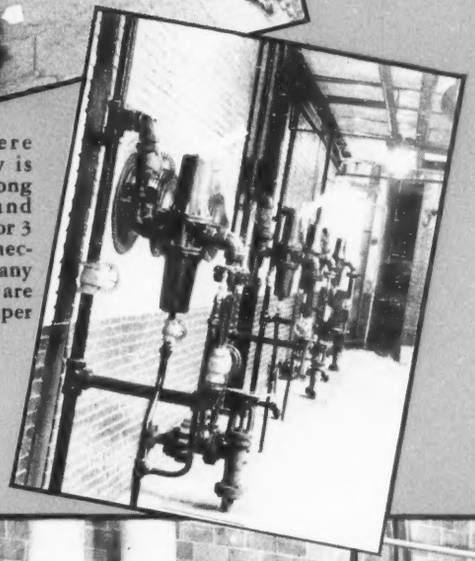
(Available for pressures up to 1500 lbs.)



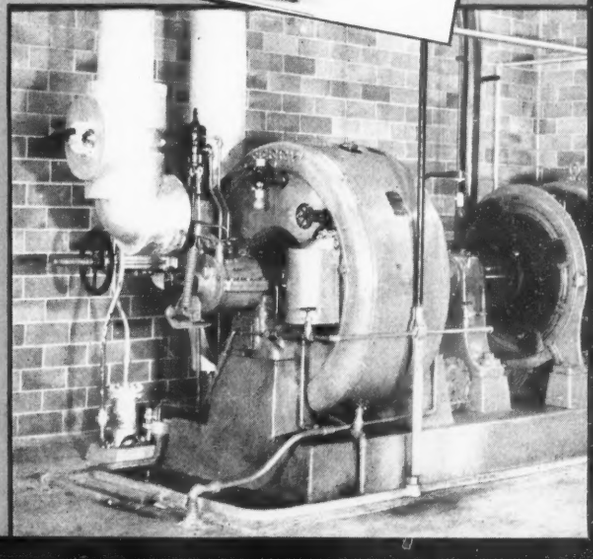
This No. 223 Special Trap, draining the separator over a large engine, has an accumulating chamber that protects the valve mechanism against pressure pulsations caused by the engine.



(Left) These eighteen plastic products molding presses are all equipped with individual No. 212 Armstrong Traps.



(Right) Where super-capacity is desired, Armstrong offers Compound Traps with 1, 2 or 3 inch pipe connections and for any pressures. These are No. 235's in a paper mill.



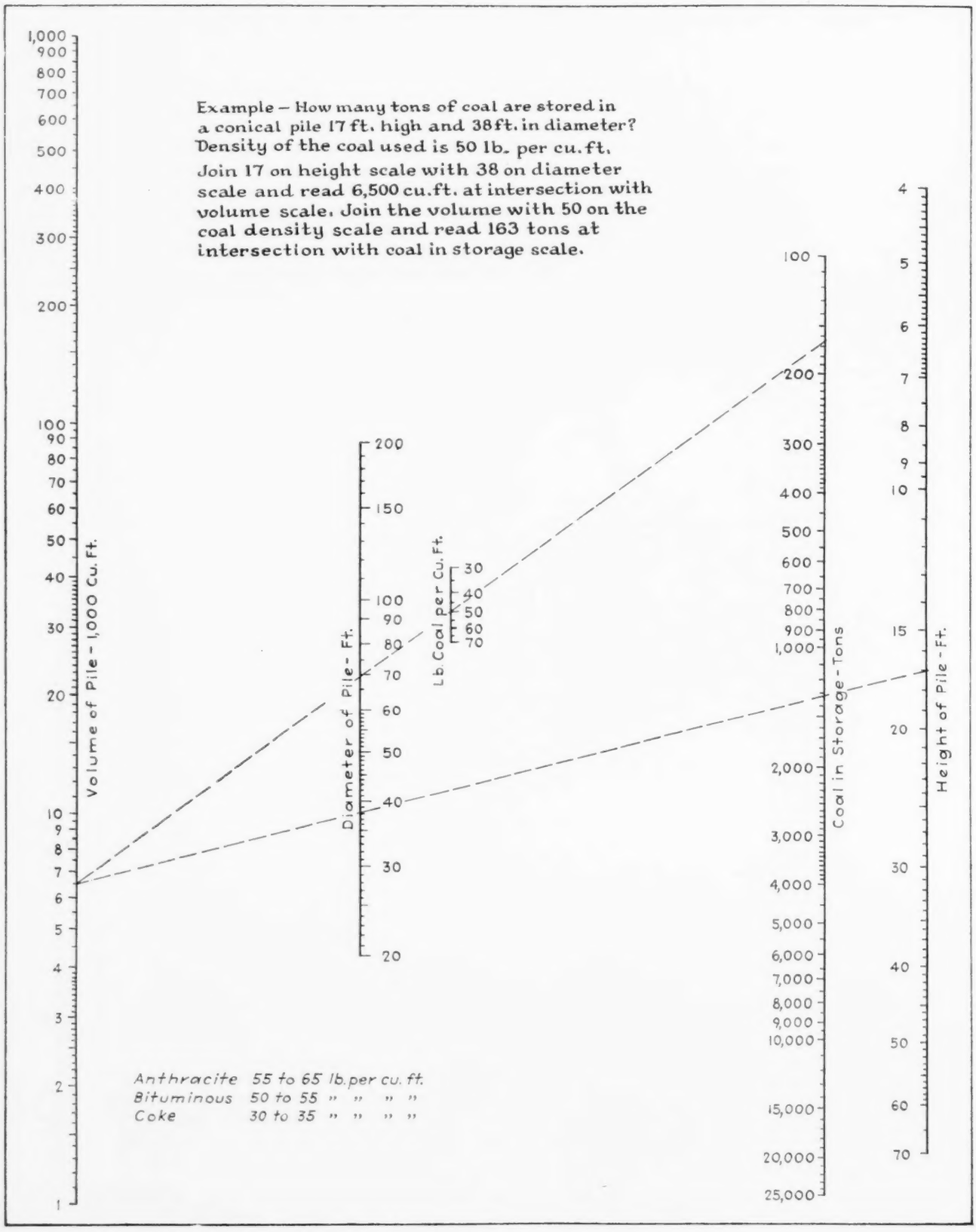
(Right) An Armstrong Forged Steel Trap is used to drain the line supplying this high pressure turbine.

MACHINE WORKS

THREE RIVERS, MICH.

Number 40

Capacity of Conical Piles For Coal Storage


Example – How many tons of coal are stored in a conical pile 17 ft. high and 38 ft. in diameter? Density of the coal used is 50 lb. per cu. ft. Join 17 on height scale with 38 on diameter scale and read 6,500 cu. ft. at intersection with volume scale. Join the volume with 50 on the coal density scale and read 163 tons at intersection with coal in storage scale.
Volume of Pile - 1,000 Cu. Ft.
Diameter of Pile - Ft.
Lb. Coal per Cu. Ft.
Coal in Storage - Tons
Height of Pile - Ft.
Anthracite 55 to 65 lb. per cu. ft.
Bituminous 50 to 55 " " " "
Coke 30 to 35 " " " "

© POWER

HIGH-PRESSURE PIPING
at U. S. Industrial Alcohol

*By J. A. Freiday**
Mechanical Engineer,
Thos. J. Murray, Inc.

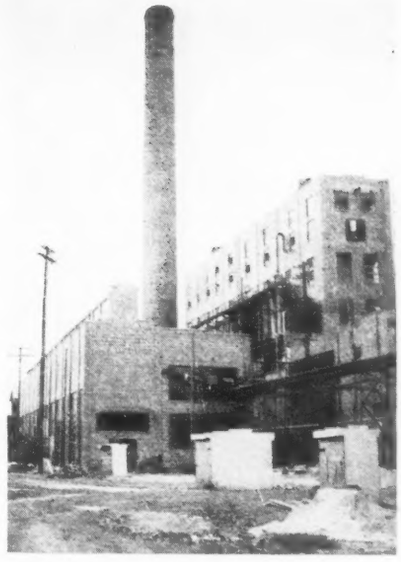
ABOUT a year ago, U. S. Industrial Alcohol Co. decided to recondition its Baltimore plants. This involved reconstruction of many old buildings, new construction and a complete new steam-generating system to supply steam for power, process and heating. The layout of the Baltimore Plants is unusual in that they are about half a mile apart "as the crow flies." U. S. Industrial Alcohol Co. is in Curtis Bay, while U. S. Industrial Chemical Co. (a subsidiary) is in Fairfield, a half mile across Curtis Bay; the distance by land is over a mile and a half. Each unit had its own steam-generating plant, operating at 150 lb. per sq.in. and sorely in need of repair. It was imperative that a new steam-generating system be provided.

It was decided to build a high-pressure, high-temperature system at the Alcohol Plant in Curtis Bay. Steam is first run through back-pressure turbines, thereby generating electric power for plant use, then taken from the turbine exhausts for process and other uses in both plants. The final design comprehends generation of steam at 625 lb. per sq.in. and 750 deg. F. total temperature. This steam is fed to two G.E. back-pressure turbines driving G.E. 2,000-kw., 2,300-volt A.C. generators. Provision has been made for an additional turbine and additional high-pressure boilers. These turbines exhaust steam at a pressure of 150 lb. per sq.in. and 100 deg. superheat which is used for process. Further, an excess of the 625-lb. per sq.in., 750-deg. steam is provided and reduced by a pressure-reducing station to plant medium pressure, 150 lb. per sq.in., 100 deg. superheat. This steam is used for process and heating at both plants. These pressures and temperatures are not high in modern central-station practice, but they are relatively new in industrial plants. All piping, from 2-in. standard weight to 14-in. O.D., $\frac{1}{16}$-in. wall Grade A seamless, has been oxy-acetylene welded.

Work was started early in the Fall of 1934, just at the beginning of peak production on anti-freeze alcohol. It was necessary therefore that this work be carried forward with minimum interference to plant operations. It was decided to recondition the old boilers at the Chemical Plant and use them during construction of the new high-pressure plant and later as standbys. In making room for the new boilers at the Alcohol Plant, it was necessary to dismantle six boilers, half of the capacity. To supply the steam required at the Chemical Plant, a 12-in. steam line was run between the two plants.

This steam line, while nothing extraordinary in diameter or length for a welded pipeline, is something of record in many other respects. It consists of 8,400 ft. of 12$\frac{3}{4}$-in. O.D., $\frac{3}{8}$-in. wall lap-welded steel pipe. More than 2,000 ft. of this pipe were erected and welded in steel structures 30 to 60 ft. in the air (see *Power*, March, 1935, pages 132-133, for story and photographs). The line traverses filled marshes, crosses state highways, city streets and a large railroad freight yard.

Work started on this line around the first of October, and steam was in the line about the middle of November—about six weeks. Welding was accomplished by the Aircowelding process employing backhand technique. Four operators were tested and qualified for this work. Two operators worked for but a few weeks in the early stages; most of the welding was accomplished with two operators. Daily weld production averaged 10 to 12 per 8-hr. day where the line runs near the ground. A few "high days" showed 15 and 16 welds. In the elevated structure, production fell to 7 to 10 welds per day due principally to extreme cold weather and high winds. The difficulty of working in the steelwork probably contributed to lowered production. These figures included so-called rolling and position welds; further, each operator lined up and tacked his own joints.

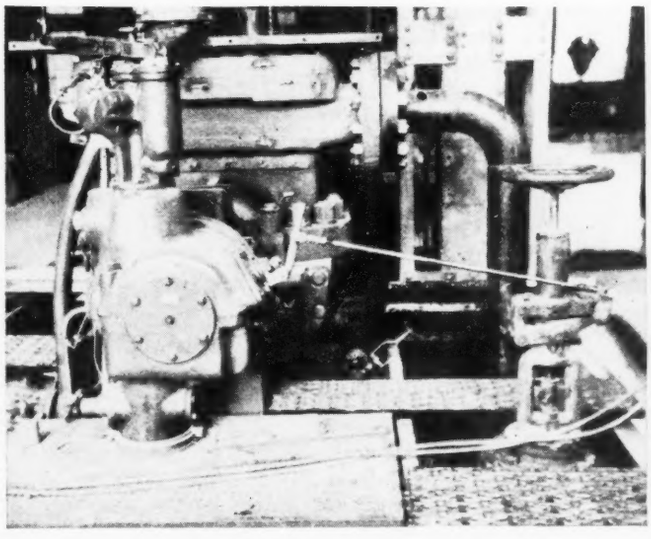


The rebuilt power house

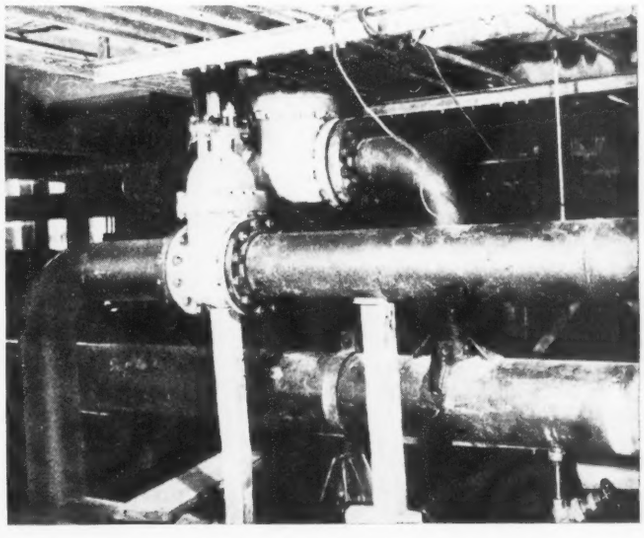
Before "tying-in," the line was blown down several times with live steam to remove scale, dirt and foreign substances. In performing this operation on one section, the steam was fed too fast, with the result that the water pocketed momentarily subjecting the line to severe shocks. The action was very close to that of a "water hammer," but fortunately did not reach that magnitude. The line could be distinctly seen to whip and sway. At one of the vertical expansion loops, the pipe was lifted off the roller supports and crashed down again with sufficient force to shear off a 2-in. shaft on the cast-steel roller and crack the base. Through all this, no failures developed in the pipe or welds. When the line was completed it was subjected to a test at full steam pressure. The idea of hydrostatically testing the line was abandoned due to the cost of filling a pipe of this size and length with water and also because of the extremely cold weather. The finished line,

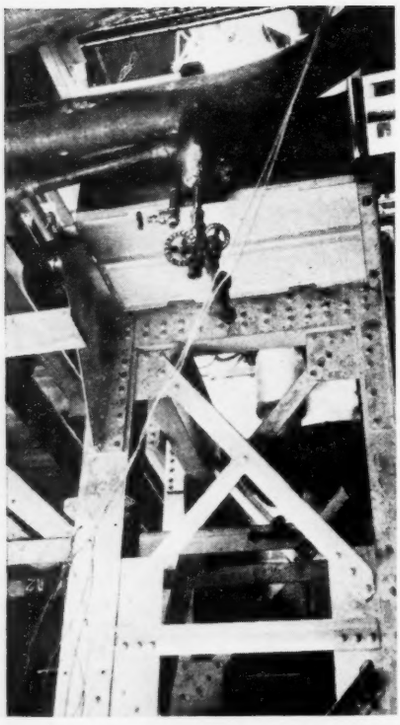
*An abstract of a paper before the International Acetylene Assn. in Cleveland Nov. 12-15, supplemented with photographs, diagrams and data from A. N. Kugler, Air Reduction Sales Co.

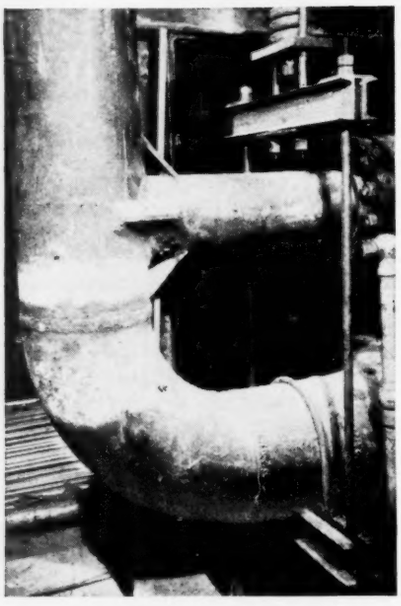
High-pressure turbine; inlet at right



Front piping medium-pressure from, rear piping high-pressure to, turbine







Top—Looking up under turbines. At center of structure is exhaust piping, at top front is intake piping and drip. Below—14-in. high-pressure drop from boiler headers. Upper outlet goes to pressure-reducing station

containing 496 12-in. line welds, 16 6-in. tee or nozzle welds, besides numerous smaller welds, did not develop any leaks or failures under full steam-pressure test. After a year in service, this line is giving thoroughly satisfactory service. Much credit for this success is due to National Valve & Mfg. Co., which erected and welded the line.

The line is covered with 3 in. of 85% magnesia Keasbey & Mattison insulation and joints cemented with asbestos cement. Outside weather protection consists of heavy tarred building paper with 4-in. lapped joints carefully cemented in place and in addition held with copper-wire banding every 4 in.

To replace six of the old boilers at the Alcohol Plant, two Combustion Engineering Co., 10,070-sq.ft., 125,000-lb. per hr., pin-tube water-wall, bent-tube boilers were installed for either powdered-coal or oil firing.

Power and other piping for the power plant was designed in accordance with the ASA Code for Pressure Piping. Since this code was not generally available, our specifications were necessarily very detailed. One deviation from Code merits mention here and involved the substitution of one test weld for the two required in the Code. Since 14-in. O.D. Grade A seamless tubing, $\frac{11}{16}$-in. wall thickness, was the largest size to be used, and further, since much of this pipe would be position welded, it was decided to make the qualification test weld a horizontal-position pipe weld on this large size. Five welding operators were qualified.

Multipass welding was employed on all the high-pressure piping, while single-pass welding was used on the medium-pressure piping. The use of multipass welding on heavy-wall pipe insures better-quality welding. All welds in the high-pressure piping 4 in. in diameter and larger were stress-relieved by heating to 1,450 deg. F. and holding there 1 hr. per in. of thickness.

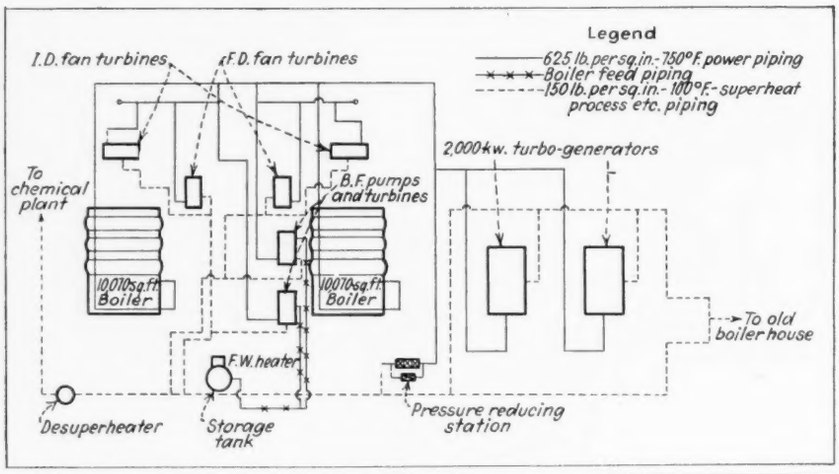
Much of this piping was fabricated into convenient shipping lengths at the plant of Pittsburgh Piping & Equipment Co. All welds in such prefabricated piping were stress-relieved at the shop. As a consequence, practically all field welds were position (both horizontal and vertical) welds and progress was slow. All field welds in high-pressure piping were stress-relieved with portable furnaces using liquefied petroleum fuel gas and compressed air. This proved satisfactory.

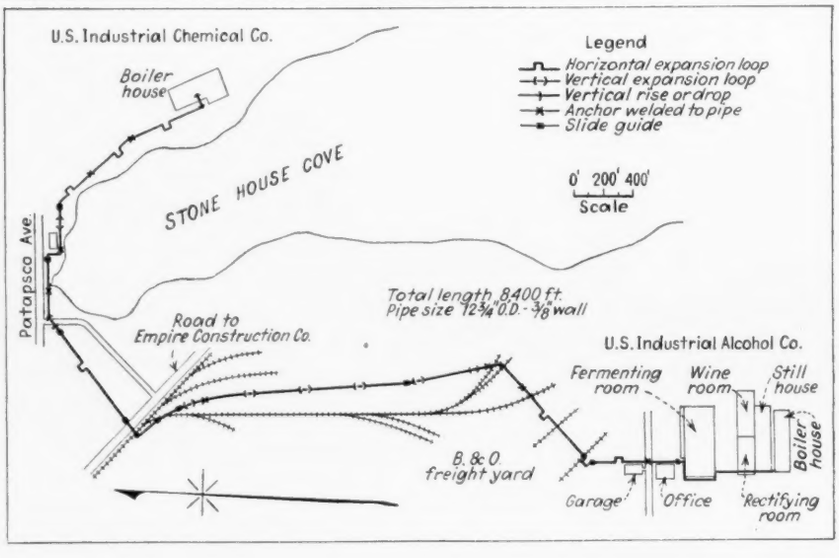
The entire power piping system was tested hydrostatically, specifications calling for $1\frac{1}{2}$ times normal working pressure. The high-pressure piping was tested at about 1,075 lb. per sq.in. which was about 100 lb. per sq.in. above the required test pressure of 975 lb. ($1\frac{1}{2}$ times 650 lb. per sq.in.). Under this pressure, each weld was hammered hard with a 5-lb. hammer, and no leaks or failures were discovered. The medium-pressure piping was tested at 225 lb. per sq.in. ($1\frac{1}{2}$ times 150 lb. per sq.in.) and no leaks or failures discovered. Under test and during $4\frac{1}{2}$ months of operation no leaks or failures have developed.

Plant engineers are well pleased with piping-system performance and operation. Actual condensation losses of the outdoor steam line have been quite close to the theoretical losses which we calculated when the line was planned. Everyone concerned is thoroughly convinced that welding is by far the most desirable method of joining pipe for steam and other services. In fact, I would hardly care to think of this type of system installed with the old-type flanged and screw joint.

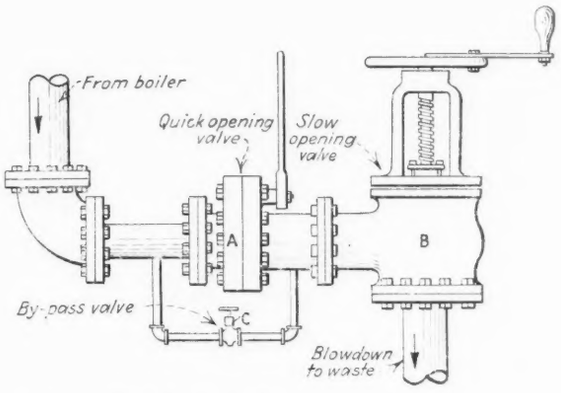
Design, supervision and inspection of the project was carried on by our organization, Thos. E. Murray, Inc. The qualification of welding operators and the inspection of welds was done by the Applied Engineering Department, Air Reduction Sales Company.

Above—Simplified diagram of power equipment and piping. Below—1½-mile 12-in. steam line connecting the two plants





PRACTICAL AIDS TO OPERATION



By-pass on Quick-Opening Blow-Down Valve

NORMAL procedure in operation of blow-down valves is to first open the quick-opening valve, *A*, in the figure, and then carefully open the slow-opening valve, *B*. In closing, valve *B* is closed first, stopping the flow, then valve *A* is closed. Following this sequence, the quick-opening disk valve usually operates with some difficulty until it has opened enough to allow pressure to equalize on both sides of the disk. This is caused by friction of the disk on its seat, while pressure is acting against on one side of the disk only. The friction causes considerable wear on the valve and mechanical parts operating the valve. Installation of a $\frac{1}{4}$-in. by-pass line and gate valve worked out satisfactorily in reducing this wear in one plant. By opening the by-pass valve, *C*, first, pressure on the disk is equalized, and the valve will operate easily. The by-pass valve is closed last. The by-pass valve and piping should be extra heavy and the line located so that it is not likely to be damaged.

Cleveland, O. M. E. WAGNER

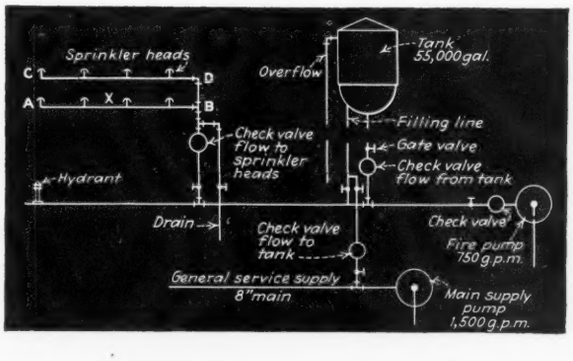
Sprinkler-System Pipes Plugged With Mud

SPRINKLER fire-protection systems are supposed to be available for immediate automatic service in case a fire occurs near one of the heads. This may not always be true, as shown by the experience in our plant, where some of the pipes were found clogged with sediment. A section of this material, forced from a $1\frac{1}{4}$-in. pipe, is shown in the photograph. Undetected, this mud gradually accumulated in the piping, to which the sprinkler heads are connected, until completely filled. When additional sprinkler heads were connected at *X* on the diagram, the supply pipe from *A* to *B* and from *C* to *D* were found to be entirely filled with mud. About 250 ft. of this piping, on horizontal runs only, was clogged. No mud had accumulated in the vertical pipes. The completely clogged pipes were found in but one of the older buildings, and these were installed about twenty years ago.

It was found that, contrary to underwriters' requirements, the faulty piping had been installed without giving it the proper slope for draining toward the vertical riser. Once each year all sprinkler heads systems are drained for the purpose of removing silt. Obviously, silt could not drain from the level runs of piping. It is evident that the piping acted as a settling basin until after several years it became completely filled with mud. To remove the obstruction the piping was divided into short sections and the mud forced out with water at 100 lb. per sq.in.

While automatic sprinkler heads are supposed to afford excellent protection from fires, undoubtedly more than one system throughout the country is connected to supply piping clogged with mud, as in this case. This experience emphasizes the need of means for draining and flushing sprinkler system piping, particularly where the water carries a lot of sediment, as in our case.

Oakland, Cal. RALPH BARR GLENN



Belt Transmits Shock to Electric Motor

IT IS generally believed by mechanical-power-transmission engineers that flat belts cannot transmit shock and vibration from the driven machine to the driving unit. Under most conditions this is true, but there are exceptions. A case in mind is where a 50-hp. induction motor connected by a flat-belt to an air compressor caused current pulsations in the power line. This trouble was traced to end play in the compressor crankshaft. Endwise movement of this shaft was transmitted through the belt to the motor's rotor, which was given an end thrust sufficient to push it out of the stator bore until the shaft hit the bearing. Opposite movement of the compressor shaft through the motor's rotor

toward the other bearing. As a result of this action the stator-circuit reactance was continually changing. An action that causes surging of the input current to the motor.

A pounding of the motor bearings by the shaft shoulders also occurred. If the motor had been equipped with anti-friction bearings the shaft could not have moved endwise. These bearings, however, would have been subjected to an end thrust that might have caused trouble.

Oscillation of the rotor and the current surges were eliminated by conditioning the compressor crank-shaft bearings so as to hold the shaft in one position.

Philadelphia, Pa. R. O. FRANCIS

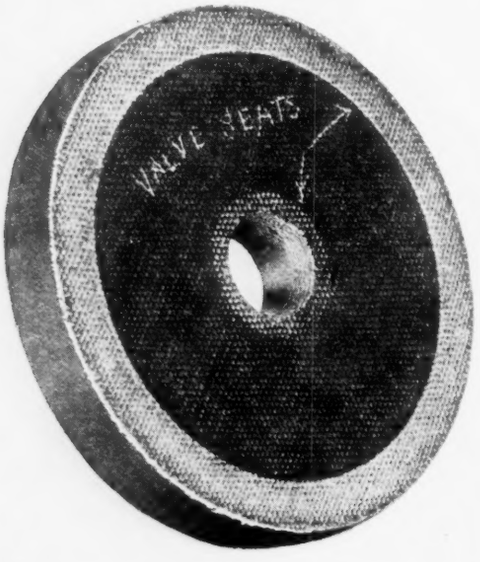
Causes of Flat Spots on Slip Rings

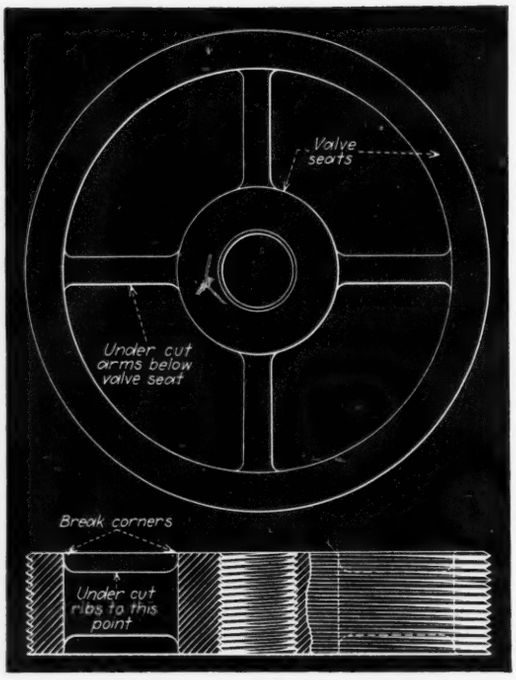
FLAT spots and burns on alternating-current motor slip-rings may be due to heavy starting current, poor brush bedding, or soft ring material, etc. Corrosion due to chemical fumes is also a fruitful cause of flats. Sparking and wear from this cause may often be corrected by using somewhat more abrasive brushes, since it is the heavy coating of oxide on the rings that starts the trouble. Another form or deterioration, however, is known as copper-picking and is met with as a rule on revolving-field alternators. In these the rings are on direct current. If sparking occurs, there is a tendency for metal to be taken from the negative ring and imbedded firmly into the surface of its brushes. Thus the negative ring appears pitted and burned, while the positive ring assumes a dark copper-color and is comparatively uninjured on the running surface. Fortunately the cure is easy. After smoothing the negative ring, merely reverse the positive and negative connections to the brush studs every few weeks.

Cleveland, O. L. L. STOFFEL
Chief Engineer
Ohio Carbon Co.

Undercut Valve Seats Increases Valve Life

THE photograph shows a valve from a boiler-feed pump that handles 210 deg. water at 150 lb. This valve is made of a laminated textile and resinous compound composition and





has been in service for 12 mo. It will be seen that the valve is worn only slightly around the stem and its outer periphery. This valve and the seven others in the pump are good for much longer service.

To get this service from the valve the valve-seats radial arms were undercut as in the drawing. Before this was done valves of the type shown in the photo leaked badly after 3 mo. service. The surface layer of material between the radial arms buckled and formed bumps that prevented proper seating of the valves.

I have undercut the radial arms of all valve seats in our pumps, including vacuum pumps, and have obtained highly satisfactory results in all cases. This includes the use of rubber composition valves as well as the type shown in the photo. Where it is difficult to remove the valve seats, the valve may be undercut over that area that would strike the radial arms of the seat.

Englewood, N. J. RUDOLPH BOETTINGER

Practice of Welding Boiler-Tube Beading

ENDS of tubes in fire-tube boilers are usually headed over against the tube sheet with a heading tool, an operation performed after the tube has been expanded and rolled into the tube-sheet hole. While undoubtedly the bead has some holding strength, this is disregarded as it is always less than the holding power of a properly expanded joint. The beading is done to prevent the exposed ends of the tube from burning off flush with the tube sheet. While the metal bead provides a direct heat conducting path between the radiant heat of the fire and the boiler water, its external surface often reaches an excessive temperature. This condition is aggravated by internal scale formation on the boiler heads, and also by increased depth and size of the bead.

Stresses put in the outer surface of the bead when headed over, make the metal more susceptible to the deteriorating action of abnormal temperatures. This results in the bead cracking, splitting, and pieces of it coming loose or burning

off. The tube ends are then flush with the tube sheet and the expanded end strength in reduced to friction in the tube hole. If a large number of tubes are so affected in a localized area, the head-bracing strength in this area is greatly reduced. In these cases the tubes with defective beading should be renewed.

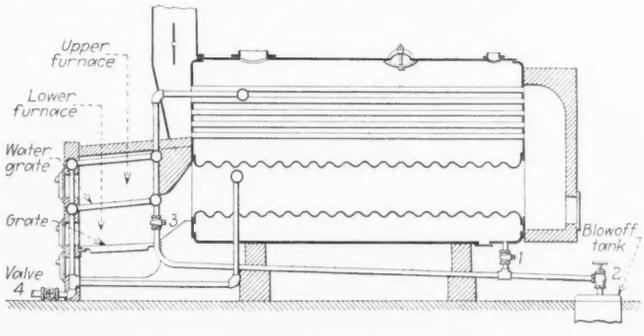
Building up the beading of tube ends by electric-arc welding is practiced widely in stationary, locomotive, and marine boilers. While this practice makes tube renewals more difficult, it adds greatly to the tube beading life, and aids in preventing leakage which may develop through expansion of the tube ends.

The weld is built up around the outer circumference of the bead about $\frac{1}{8}$-in. deep by $\frac{3}{16}$-in. wide. This practice may be followed where the beading is likely to give trouble, as in boilers which are forced at higher than normal ratings. It should also be done where indications of cracking or burning of the beading are visible. Welding of the tube beading should not be done in such cases as in a boiler having badly pitted tubes, and tube renewal is necessary in the near future.

Philadelphia, Pa. B. A. BRIGGS

Increases Water Circulation in Scotch-Marine Type Boilers

POOR circulation of water under the corrugated flue at the lower sections of the shell is a characteristic of Scotch-marine boilers. I had charge of two large boilers of this type that supplied steam to a heating, ventilating, and air-conditioning system in a large building. Periodic operation at short intervals throughout the heating season was required. Also climatic changes at the beginning and ending of the heating



seasons made necessary daily starting and shutting down of the units.

Having down-draft furnaces with water grates and piped as in the figure, I decided to use the blow-off piping system to provide circulation of the water in the interior of the shell and water grates. This was done by closing main blowoff valves 2 and 4. The blowoff cocks 1 at the boiler and 3 at the water-grate connections were opened during the initial and operating periods of the boilers. This procedure exceeded the operator's prediction as to rapidity of water circulation and steam generation. The comparatively cool water from the lower sections of the shell under the large flues flowing through the rear blowoff connections to the blowoff connections at the lower section of the water grates was heated quickly due to rapid heat exchange of the water grates. This thermal action resulted in rapid circulation, elimination of stagnant water spaces and unequal expansion and contraction strains on the boiler material. Time for initial steam generation of this type of boiler with the large volume of water required about $1\frac{1}{4}$ to $1\frac{1}{2}$ hr. under the original conditions. When the blowoff system was put into service to increase circulation, this time was reduced to 35 min.

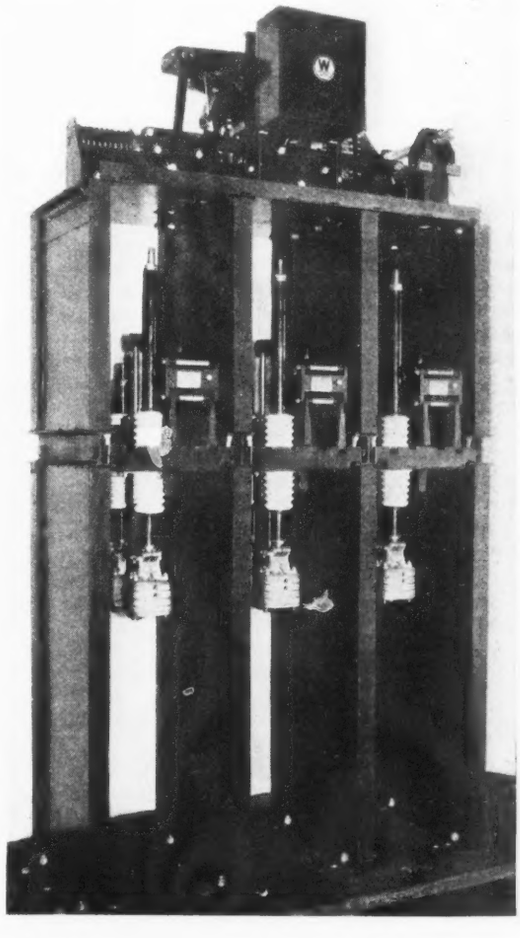
Chicago, Ill. THOMAS J. BRITT

Steel Walls for Cell-Mounted Circuit Breakers

AN EXTENSION was to be made to an existing concrete structure to include two additional circuit breakers. It was desirable to keep the cost down to a minimum and to eliminate if possible, the dirt incident to adding the new barrier walls to the concrete structure. Inasmuch as adjacent circuits were to be alive, it was also desirable to keep the amount of work in the structure down to a minimum. Steel barriers, mechanically duplicates of the existing concrete walls were built adaptable for mounting to the floor and to the back wall. The work of preparing for these walls consists only in setting anchors for the bolts, in the floor and the back wall.

The four walls were quickly put in place and the circuit breakers mounted on them with a minimum of work. The figure shows one circuit breaker assembled in the frames and adjusted ready to have the tanks put on, thus completing the preparation for service. Work of building forms and pouring concrete was completely eliminated and the entire breaker ready for service in considerably less time than required to build a concrete structure.

East Pittsburgh, Pa. E. K. READ,
Circuit-Breaker Engineer
Westinghouse Elec. & Mfg. Co.



CURRENT COMMENT

Desliming Condensers with Chloramine

ON PAGES 611 and 612, November *Power*, were published several answers to the question of A.H.W. relative to chemical desliming of condenser tubes. As might be expected, since the writers were primarily engineers, these letters revealed some confusion in matters of bacteriological chemistry. Operators of condensers may therefore be interested in the "slant" of a chemist on this practical problem.

Condenser slime is generally caused by algae and encapsulated bacilli. The most frequent form of algae found in condensers is a form of iron bacteria easily recognized under the microscope by its long filaments inclosed in a gelatine-like substance. These bacilli have the ability to grow a gelatine envelope which may increase their size several times. In most slime one finds many diatoms, protozoa, particles of sand, etc., held in the gelatine formation of algae and bacteria. Without these growths the sand and diatoms would be washed through the condenser and cause no trouble.

None of the bacteria mentioned, or for that matter any other bacteria, are "immune" to chlorine provided the dose is large enough and the contact time long enough. This idea of immunity has probably developed from a confused conception of the tolerance which bacteria can develop for a disinfectant. Bacteria, like people, can get used to increasing doses of poisons.

If the applied dose is not of sufficient concentration and duration the bacteria may be revived when the raw water is circulated again. Each time this is done the bacteria develop a greater tolerance, until such a high dose is required to kill them that they seem to be immune. Therefore, longer and less frequent treatment would be more effective. Proper length of treatment depends on the resistance of the bacteria and the extent of slime formation. Even in extreme cases, treatment need not exceed 30 min. Frequency depends primarily on temperature, being greater in the summer when the temperature is best for the growth of slime-forming organisms. Source of contamination also has some effect on this, but it should never be necessary to treat more than once a day. Experience is a safe guide in this matter. In the case of A.H.W., it would seem likely that the increasing chlorine demand of the water had left no residual chlorine for sterilization. An increased amount of organic matter (from industrial waste or sewage) could cause this. Since the demand is apparently high and uses up chlorine rapidly, it would be much better if A.H.W. could apply the chlorine nearer the condenser. Alternating the use of chlorine and ammonia would not break down the resistance of the bacteria. In fact, it would do nothing but waste ammonia, which has practically no sterilizing value at that concentration.

Such impressions as this are reasons for the fundamental objection to calling the Chloramine process the Ammonia-Chlorine process. The chloramines, namely monochloramine (NH_2Cl) and dichloramine ($NHCl_2$), are distinct chemical compounds and are formed only when a hypochlorite and an ammonium compound are applied at the same time and in the proper ratio. Probably the simplest and most economical method is to use calcium hypochlorite and ammonium sulphate. These should be dissolved separately and introduced simultaneously, the hypochlorite being introduced downstream from the ammonium sulphate. The correct ratio is approximately 5 to 1. Best point of application is at the circulating-pump inlet. It has been suggested that ammonium chloride be used in place of ammonium sulphate because "more chlorine would be available." Chloramines would be formed as easily with ammonium chloride as with ammonium sulphate, as only the ammonium radical is involved, but the chloride is more expensive. The chlorine in ammonium chloride, being in the form of chloride, is not to be confused with chlorine in the form of hypochlorite, which is what is necessary.

Chlorine as such, or more properly hypochlorites, are never found in untreated natural water. However, it is usually found in the city water supply, for the waterworks tries to carry a residual through the pipes to the consumer to prevent subsequent contamination or regrowth after the water has been sterilized at the filtration plant. That is why most cities use chloramines, for they are more stable and will maintain a protective residual longer.

Chlorine is *not* one of the decomposition products of decaying animal and vegetable matter. If it were I could mention several stations, notably those on the East River, New York, whose water would be so saturated with chlorine they could probably extract it for commercial use and keep their condensers clean too. As a matter of fact the reverse is true; water containing decaying animal and vegetable matter is an ideal medium for the growth of slime-forming organisms, and the decomposition products take up added chlorine to form compounds that have no readily applicable value as sterilizing agents.

New York, N. Y. I. B. ROMANS

Cutting in a Boiler

MR. HAFFORD'S quite natural disagreement, in December *Power* (Current Comment), over our cutting a boiler into service when slightly below line pressure is only remarkable because it is the first adverse comment about "Steam Plant Errors" from any source as the booklet has steadily spread around this and some foreign countries. The single chapter in October *Power* could not cover the entire groundwork on which the decision of the problem is based, so I immediately sent him a copy asking that he let us hear whether he still believes it is misleading for the young firemen.

The explanation of the effects of common steam facts and natural laws, in boiler operation, clashes with many inherited opinions and steps pretty hard on many toes. But operating engineers should understand that no blame rests on them for the false, often conflicting, instructions in old texts, "standard rules" and theories.

I believe this application of well-known facts and laws serves as a sort of snubbing post by which anyone can subdue the most spirited creature that struggles against it. The more powerful or stubborn the adversary, the more injury he does himself by refusing to grasp the full significance of these familiar things—in actual operation.

However, I will be the first to welcome any definite showing of material mistakes in the explanations, for the sole objective is to improve the standards of the trade through study and discussion.

Seattle, Wash. FRANK H. BROWNING

Only 99% Perfect

I HAVE read your splendid article, "Spotless Dixie Plant," in the November number of *Power*. Your pictures of the installation are most attractive, and your description is set in a style which brings out the romance of power.

In spite of all this, however, I can rate the article as being only "99%" perfect, because of your statement, "In typical operation CO_2 is maintained at about 14%." As you are no doubt aware, typical operation of this plant is controlled by the steam flow-air flow relation of the Bailey boiler meter, without any reference to a CO_2 recorder. Therefore, would it not be more nearly correct to refer to typical operation in terms of "per cent total air"?

Cleveland, Ohio E. B. BOSSART
Bailey Meter Co.

[While the point noted is not literally an error, it does, as Mr. Bossart points out, tend to mislead. We stand corrected—*Editor.*]

Rising Diesel Exhaust Temperature

IN ANSWER to your September question on rising diesel exhaust temperature during an operating day, I would like to suggest that this might be caused by:

1. A sharp rise in back pressure on the compressor usual in winter operation may be causing too much overload on the engine, while the seasonal drop in head pressure on the compressor does not compensate for the rise in back pressure.

2. If the load is actually less than in summer, the drop might be such as to make valve timing improper for this load, resulting in a hard-running engine and detonation. This trouble is sometimes evidenced by a smoky exhaust if not to the ear of the operator. Sticking, leaking or warped valves can similarly cause this indication of trouble.

3. Fuel injection may not be timed correctly for the new winter load or nozzle capacity and pressure at fault, bringing about incomplete combustion or lagging combustion. Often, "after burning" (near the end of the expansion stroke) occurs, which heat

evidences itself in a high exhaust temperature and some times a smoky exhaust.

4. The water jackets may have become scaled or full of sediment aggravated by frequent shutdowns. Keeping jacket water circulating for a time after the engine shuts down will help prevent scaling, since no water is thus allowed to be kept in contact with a hot cylinder, and thus rise in temperature above the point where scaling occurs and accumulates in the engine jackets.

In the order of probability as to the cause of the trouble, No. 4 ranks first and in order after, Nos. 2, 3 and 1. A pressure card taken on the engine or an 180 deg. crank indicator card on the engine will reveal troubles of the nature of items 2 and 3. First, however, clean out the jackets and look for sticking or leaking valves.

New York, N. Y. R.T.B.

FEDERAL LICENSING—YES OR NO?

***Editor's Note*—In September (1934) *Power*, page 496, appeared Chester G. Robinson's proposal that the Federal government license power-operating engineers. A number of comments have been received. Excerpts from four appeared in November, 1934, page 609. Here are five more.**

Labels Don't Make Men

IN ANY profession, a man's reputation depends upon himself regardless of diplomas, licenses, etc. However, certification of engineers is necessary in order to control the practice of engineering. Such practice involves the safety of life, health and property, as well as the spending of public money, and should be done by qualified men only. Otherwise there is no insurance against improper planning, inefficient design, wasteful execution, excessive cost, misinformation and dishonorable dealings. Structural adequacy alone is not sufficient.

Certification is also of great value to engineers for their own protection and convenience in cases such as change of location, change of employment, membership in associations, etc. Indorsement by a recognized agency such as a State Board of Engineering Examiners can be accepted without question as to a man's character or his qualifications as a professional man.

A diploma from a first-grade engineering school certifies the passing of examinations in basic engineering, but a holder of an engineering diploma may or may not have adequate practical experience. Membership in engineering societies does not necessarily indicate a common background of basic engineering education; it may or may not indicate engineering experience.

The medical profession has found it profitable to require its practitioners to meet by law certain minimum requirements of education and experience. Members of the medical profession are licensed for medical practice, not for some branch of medical practice. Admission to the bar in the legal profession has the same basic effect as licensing in medicine.

In contrast with these professions, the engineering profession appears to be at swords' points with itself in regard to qualification. Instead of realizing the importance of qualifying as "engineers," many of the men who claim to be members of the profession apparently wish to place all sorts of restrictions on themselves. They go out of their way to specify what "kind" of engineer they are, instead of being engineers specializing in the branch that they choose.

Mr. Swain, in his editorial on page 660 (December), says ". . . the operating man can rarely get by as a diesel specialist alone. In industry, at least, the diesel is always hooked to other machinery and associated with all kinds of power equipment. More often than not, the man looking for a diesel job will find that he is expected to know a lot about electricity, pumping, refrigeration, heating and ventilating, air compressing—probably boilers also."

Circumstance may force a "diesel engineer" to be one of the many other kinds of engineer, which, when classified legally or otherwise, cause great personal inconvenience, as well as the setting up of barriers to the advancement of the engineering profession to a higher, all-inclusive plane.

The present system of municipal licensing of power-plant operators as first- or second-class engineers, etc., should be discontinued. Operators of boilers, steam engines, diesel engines, locomotives, etc., should be licensed by the state as "operators" just as the driver of an automobile is licensed by the state as an operator—not as an engineer.

Power-plant operators who qualify as licensed professional engineers should need no further license for such work. This viewpoint aims high and should eliminate Mr. Robinson's objection that power-plant men have been "lost in the shuffle."

This plan gives an equal chance to all men whether they be graduates of the school of hard knocks or graduates of engineering colleges. Anyone desiring to call himself an engineer should be required by the engineering profession to qualify for basic engineering education and minimum active practice satisfactory to the examining board.

In an article entitled, "Shall Registration Classify Engineers?" Dr. D. B. Steinman, president of the National Society of Professional Engineers and former chairman of both the National Council of State Boards of Engineering Examiners and New York State Board of Examiners for Professional Engineers, as well as a member of the Engineers' Council for Professional Development, states:

"Any classification or differentiation in the certification of registered engineers is to be deplored as a step in the wrong direction, laying the foundation for future jurisdictional disputes and for disintegration of the profession. Registration should be on the basis of a single profession of engineering. Just as every lawyer or physician is trusted by statute to practice in the broad field of his profession without restriction to a branch or specialty, so every Registered Professional Engineer should be trusted to practice in the broad field of engineering without statutory delimitation. The individual engineer, knowing his own limitations and second to none in professional honor and integrity, can be trusted not to overstep the bounds.

"The examinations for registration, as well as the accompanying investigation of professional record and character, should be designed to satisfy the board that the candidate can safely be entrusted to practice as a professional engineer without other limitation than his own conscience and the opinion of his fellow-engineers may prescribe.

"The desired picture of a Professional Engineer, to be brought out by this plan of examination, is a man of high intellectual honesty; thoroughly trained in the common basic fundamentals underlying all engineering work, with some essential knowledge of the elements of all branches of engineering, and with additional specialized knowledge and training in one major branch of engineering. The better engineering schools have curricula designed to meet this specification. The State Boards should design their examinations to test the fulfillment of this specification. If this were universally done, every registered Professional Engineer could be certified as fully worthy of the complete trust implied, and the pressure to segregate and delimit engineering practice would be nullified."

Rockville Centre, N. Y.

HAROLD R. TOWSE

Earn the Respect You Want

MR. ROBINSON'S proposal in the September number of *Power* for federal licensing of operating engineers has attracted very interesting comments in recent issues. They reflect the general feeling that something is decidedly wrong. They even recognize the fact that this trade has not enjoyed public esteem.

Before considering the merits of federal versus state or municipal licensing, it would be well to locate the basic trouble with the trade, make some effort to deserve respect as a genuinely skilled trade, and also determine the true purpose and authority for licensing. If the examiners were to be held responsible for the entire scope suggested by Mr. Robinson, it is clear to me that each licensed man must operate about a hundred plants, for there are not enough such qualified men to keep up steam in many. Proper training is very scarce.

Present chaos in the trade evidently comes from old rule-of-thumb methods and peculiar superstitions engendered in early industries before our modern scientific basis came into prominence. Everyone feels pious with some "standard rules" posted in the boiler room. No one could really understand them. They have been passed along as edict and dogma by "authorities," though with remarkable divergence among the leading services—stationary plants, Navy, railroads and others. As we cannot conceive boiler plants behaving according to many conflicting opinions, I believe the first correction should require study and clear understanding of boiler operation before a man starts as a fireman. This drastic change from present standards approaches

requirements for the electrical trade, which now enjoys public respect, based on a mental grasp of unseen properties, rather than strength, habits and rules.

As to licensing, we find the only authority in the police power of city or state, that is, regulation for protection of the public. We are informed nothing more is lawful. Most of the present licensing standards range from poor to terrible. Almost none of them come closer to the safety measures than examining the applicants' mechanical aptitude and routine practice. Many of them require study of technical formulas which have absolutely no operating significance and merely distract attention from the principal purpose of license laws—intelligent prevention of the hazards. The license certificate is merely an endorsement for safe operation, and not to cover all desired abilities and efficiencies.

I am not one to believe that selection for a federal job suddenly endows a person with superior ability. In fact, I sincerely hope no federal licensing is undertaken until some decent standards in the states develop the needed talent for centralized regulation on a proper plane.

And finally, the next time anyone complains about the prevalent lack of respect for this trade, tell him to study, think, discuss operating conditions and help his fellows until he is free from any responsibility for that regrettable condition.

Seattle, Wash.

FRANK H. BROWNING, M.E.

Present System Is All Right

CHESTER G. ROBINSON'S proposal may or may not be worthy of a great amount of controversy. It seems to me that with the present state of affairs the Federal government has enough business to entertain it for quite a long time without interfering with state affairs of this nature to any great extent. I think one will find most states with fairly strict examinations, and those given in this state are not to be sneezed at. Anyone thinking so has only to step into one of the offices of the district examiner and try his luck. Regardless of the size of plant, whether it be 1,000 sq.ft. or 1,000,000, it requires just as much knowledge to operate properly.

Political influence in this state is not tolerated. You take your examination, answer your questions fully and to the satisfaction of the examiners, who are men who are capable and intelligent.

In regard to engineers getting lower rate of wages than firemen in some spots, I refer discussors to the old adage, "You're either worth no more or you lack ambition to secure something better." So, personally, I think it is a needless waste of time to debate a matter of this nature at a time like this. Furthermore, state laws cannot be so very lax everywhere, because we do not read or hear of very many great disasters due to faulty engineers. Our modern automobiles cause more deaths in one year than do steam boiler and engine failures and electrocutions in the power field in 20 years.

I think most states have things in a very good state, or the Federal Government would have been "on their necks" years ago to better conditions in this field of endeavor.

Fairfield, Ohio GLENZA KOONTZ

Minority of One

I APPEAR to be a minority of one in my opposition to Federal licensing of stationary engineers. My opposition still stands, however, and I feel that, did the advocates stop to consider the matter more fully, they would agree with me.

It is most unfortunate that we in this country are cursed with short memories. Does anyone recall the "Observation," which had a serious accident with great loss of life aboard? Does anyone remember the "Morro Castle" of recent fame? Do the readers of *Power* realize that both these vessels were under Federal inspectors and were operated by men with Federal licenses? Did that fact have any effect on the bad condition of affairs both as regards personnel and mechanical operation? Do any of the readers of *Power* recall the "Vestris"? Although that vessel was under the British flag, the Steamboat Inspection Service was somewhat concerned and conducted an investigation after the accident. This investigation included an inspection of one of the sister ships and I was aboard the same day.

Without casting any bricks, most of the investigating committee did not get past the salon, where a sumptuous meal was served, and those who did make an effort to probe into defects and probable causes were shown only those things that they were allowed to see.

No one can blame any company for this; they are in business for themselves and pay their taxes to support the various Government agencies and also pay their insurance premiums. They are, in these matters, exactly like the folk who return from abroad with some small contraband in their grips. They take a sporting chance of getting through the Customs, knowing that they are doing wrong. It would be suicide for a company to adopt a lofty, altruistic attitude and equip their ships or, on land, their power plants with every safety device.

The fault lies with the inspection services and the men who hold licenses issued by them. If the Federal agencies were truly impersonal and operated *pro bono publico,* as they should because it is that same public who foot the bills, they would obviate all such disasters and laxities by stricter attention to their duty. If the holders of Federal licenses knew they were backed 100% by this same Inspection Service, they would report these irregularies and get them corrected in all ships and companies, and the extra expense would fall on all the companies concerned and would not conduce to unfair competition.

When that happy state of affairs eventuates then, and then only, let us tack another Federal agency onto the already long list. Before that happens, Congress must do preliminary work. They must make the Steamboat Inspection Service absolutely apart and distinct from any political influence of any kind. The Inspectors must know their work and, what is equally important, know that their jobs are quite secure and more on a line with the present-day Federal judges' status.

They must know that, when they find a fault, it will be corrected whatever the cost, and no questionable influence will be able to prevent it. When they know this they will be encouraged to closer inspection, and the whole situation will be bettered.

Until that Utopian time, I feel it will be better to let matters rest as they are, in the hands of the state inspectors who, I maintain, are excellent men and singularly free from political considerations. At least, they know the condition in their own state and are, quite often, in personal touch with many of the engineers operating under their licenses. It is public indifference that is to blame for any condition which they could perfectly well change by the action of their elected representatives in Congress. Until the public memory becomes a little longer and more retentive, we shall get no change, and our best plan will be to let matters remain *in statu quo* and not place another Federal agency on the list.

Passaic, N. J. MARK BELL

Politics Is No Substitute

I HAD an experience with an examiner who was appointed because he was a Republican, certainly not for his qualifications as an engineer. My way of locating dead centers by the trammel method was new to him, so I was asked to explain why I did not level the connecting rod by the "eye." Suppose the engine was on an angle or inverted, then what? With my method I got the actual dead center with no level, protractor or plumb around. A license by this system means that where ability is lacking, political influence qualifies dubs and defeats the object "safety first."

Again take the Great Lakes rule: How long you have served as a fireman, oiler or assistant is important to get a chief's papers. Some system, eh? I recall a yacht built in Cleveland for the Lakes was sent to the Atlantic for Cuba. It got to Havana with no end of trouble due to a Lake chief engineer and a saltwater British-trained second who could not tell this Irish engineer anything, so he let him find out for himself. The chief went home as a passenger, and the saltwater second brought her home after he had dug out the surplus salt and delayed the visit to Cuba for time to settle the issue with the boss back at Cleveland, plus the job of cleaning boilers to make room for water to generate steam.

I recall a case where the roller (boss of a rolling mill) hung a brick on the governor to get more speed. This engineer did not realize the danger until a section of the flywheel decided it would leave the wheel. It took flight through the roof and dug into the office lawn so deep that it was left there.

Engineers who qualify for British papers must have: training as engine builder to qualify on a job as third in a steamer of qualifying power and rating to carry three engineers, each qualified to take a "watch" and be in actual charge (not as an assistant). One year of sea service, and second papers may be applied for. After one year more, chief's papers are available after certain qualifications as to construction, strength of materials and the general theory of steam control and its application from boiler to feed, its value, etc., are met.

Examination by all means, but not of the kind we find resulting from political influence! Why qualify an incompetent? Practical training and experience are virtues.

Cleveland, Ohio JAMES MCINTOSH

QUESTIONS for Our Readers

Removing Stuck Tube Cleaner

Question 1

WHAT *is the best method of removing a rotary tube cleaner that has stuck in a tube of a bent-tube boiler?*—J.F.

Flarebacks on Low Loads

Question 2

WE HAVE *a pulverized-coal installation in our plant. The burners are of the horizontal-cone type and the pulverizers are unit impact machines. On low loads, we have considerable trouble with fires going out, often resulting in flarebacks before the operator can get them going again. What causes this and how can we prevent the trouble?*—H.S.

Suitable answers to these questions from readers will be paid for if space is available for their publication.

POLISHING THE PLANT

ANSWERS to November Question 1

The Question

MY PLANT *has the conventional brass railings around the engines and compressors, tile walls and cement floor. I've had considerable trouble keeping the railings shined, because people touch them. If I use a light film of oil, they collect dust and are disagreeable to touch. I also have a lot of brass-trimmed apparatus. Is there any substitute for the usual hand polishing. Couldn't I use painted or enameled railings that could simply be washed down? I have the floors painted and thus avoid trouble with oil spots, but any spattered oil makes it very slick. What paint should I use? Further, oil is occasionally thrown from flywheels against the tiling and soaks into the mortar between tile-faced bricks. How can I remove and thereafter prevent this discoloration?*—A.W.W.

Use Lacquer and Guards

THE idea of A.W.W. in covering brasswork of his power plant with a coating of paint or enamel would be satisfactory in so far as eliminating the necessity of polishing. However, in the opinion of many engineers, polished brass on instrument boards, railings, etc., adds to the appearance of the plant.

Brasswork does tarnish easily if exposed to the oxidizing effect of air. A film of oil will prevent this oxidization or tarnishing, but it causes dust to adhere to the brass and gives added work from this source. A practical method of keeping brasswork bright, and minimizing labor is to bring it to a high polish with a polish that leaves a dry surface. Immediately after this polishing, a coat of high-grade lacquer should be applied. This lacquer will prevent oxidization or tarnishing, and oil may easily be wiped from such a surface.

There is no paint which may be used to prevent an oil coating from making a floor slippery. It seems that good plant management should aim towards eliminating oil spattering by proper guards and avoidance of excessive oiling.

Stained surfaces of concrete should be cleaned in the following manner: The surfaces should be scraped thoroughly and scrubbed with gasoline. (Incidentally, care should be taken against ignition of gasoline fumes.) In extreme cases where oil has penetrated the surfaces of the concrete, it is necessary to chisel off the discolored surface and apply a coating of fresh concrete. Several types of anti-acid paint are on the market in various colors which may be applied successfully to concrete. The surfaces must be dried thoroughly before applying any paint. Any concrete exposed to oil should be protected by several coats of such a paint.

Boston, Mass. HARRY M. SPRING

No Time for Brightwork

I AM not in favor of brass trim on engines or apparatus except for thermometers and pressure gages. If I were A.W.W., I would paint all the brass except as noted above with a good enamel such as is used on the engines. Brasswork looks nice when polished but if you have a large engine room and several units you can find enough work to keep the men busy without polishing a lot of brass.

As to the floors: We painted ours in two different colors to resemble tile and gave it a good coat of varnish. We revarnish every year, which keeps the floor in good shape. We made mats of "Mule Hide" rubberoid roofing. These are laid where the traffic is heaviest and painted and varnished. We have some mats that have been on the floor eight years and still do not show signs of wear. The thing to do with the slippery floors is to wash them and then wipe up every time a drop of oil is spilled. For cleaning the walls, try "Soilex" or some other cleaner. But I would wipe the oil off until it was fairly clean and then give the mortar joints a coat of aluminum paint to seal in the oil, and finish with a coat or two of white enamel. Of course all this cleaning is going to be just so much extra work if the oil is not stopped from leaking onto the flywheel.

Lubricating oil is purchased to oil the bearings and cylinders of the engine. A little time spent in stopping the leaks and cleaning up all spilled oil will soon pay in reduced operating costs and may save a bad fall, causing unnecessary pain and expense.

Walthill, Neb. WM. W. DINGWALL
Central States Electric Co.

Maintain the Plant Properly

NOTHING sets off the well-painted and maintained commercial power plant as much as well-polished metal or plated metal work. This may be either brass, nickel, or chromium. Brass may be given a very high polish with some commercial polish, or polished with a mixture of lampblack and alcohol mixed to a paste. High polish may be protected by coating polished pieces with automobile wax, well-rubbed. This will result in a surprising amount of protection. Additional protection may be given polished parts by coating them with good-grade lacquer, or a lacquer made by dissolving clear celluloid in acetone. Paint or enamel will give good protection, but much of the attractiveness of polished surfaces is lost beneath any colored paint.

There are several methods of preventing painted floors from becoming slippery from oil. The cause of the oil spatter must be determined and stopped if possible. Barring this, sawdust may be placed in convenient receptacles for easy scattering over oily surfaces. This should be given time to absorb the oil, then swept up and burned. Paint may be mixed with white sand and when applied presents a rough surface that is not slippery but is rather difficult to mop or sweep over.

When oil is thrown from the rotating parts of the machinery, it might prove feasible to cover the guilty parts with a galvanized cover to prevent further damage from oil spatter. The oil may be washed from tile and mortar with a strong soap solution applied with a stiff bristle brush. Several commercial soaps are on the market and are excellent for cleaning oil spots from concrete, tile, or brick walls. A heavy coat of white shellac after washed locations have throughly dried will prevent further trouble. A coat of aluminum paint followed by a wash of cement and water will effectively hide discolorations and will prevent oil from working out of the building material.

Wood River, Ill. H. F. DAWE
Maintenance Engineer

Use Aluminum Paint

WITH the development of the modern power house, old-fashioned brass railings have become more or less of a memory, due perhaps to several reasons. For economical reasons the operating force has been reduced to a minimum, and remaining operators do not have time to polish hand rails. It has long been decided that the expense and labor of keeping brass handrails polished was unjustifiable. Therefore it is common practice to use iron pipe somewhat lighter than standard pipe, and special rail fittings, of which there are several types. These are then painted any desirable color.

Since the development of the so-called aluminum paint, it is perhaps the most widely used paint for general power-house work. This paint is composed of a vehicle with a metallic flake-like pigment and is essentially different from other paints. The pigment is pure aluminum-bronze powder, and is made by mixing this powder with the proper oil, or a long-oil spar varnish in the proportion of 2 lb. of powder to one gal. of vehicle, which gives a resulting mixture of about 21% of pigment and 79% vehicle, measuring about $1\frac{1}{8}$ gal. This paint is easy to apply, covers well, giving a uniform smooth appearance, and does not chip, crack or peal. It dries quickly, leaving a thin coat of metallic aluminum, which is opaque to the sun's ultra-violet rays and protects the vehicle from injury. Although one coat will cover a black surface, better results are obtained with two coats. When dry, the surface may usually be cleaned with a dry rag or soap and water. Dust does not adhere easily to this surface.

I would suggest that A.W.W. thoroughly remove the polish and foreign substances from the brass and give it two coats of this aluminum paint, allowing 48 hours drying between coats. If a contrast is desired, the rail fittings could be enameled some other color. Black enamel is often used.

About the only remedy for oil spots on the floor is to wipe them up, or place shallow neat pans around to catch the drippings, if it is not possible to stop the leaks.

Oil soaked into the cement between the tile joints may be removed by scrubbing the joints with a brush dipped in a saturated solution of warm soda-ash. This soda-ash is then flushed off with clean water, and after it is thoroughly dry the joints can be painted with a clear varnish. Any varnish getting on the tile can be removed easily while still wet. Rubber gloves and goggles should be worn when applying soda-ash.

Waynesboro, Va. J. M. MYERS

ROCK SALT IN THE FIREBOX?

ANSWERS to November Question 2

The Question

WHAT *are the advantages and disadvantages of using rock salt in the firebox for disintegrating soot? Are there any special products for the same purpose?*—H.K.T.

Hot Fire-Excess Air For Best Results

ROCK salt and several other compounds have been found effective in removing soot. Such compounds, when thrown on a fire bed, vaporize and form a coating over the soot. Thus coated, the ignition temperature of the soot is reduced, so that the heat of the fire is sufficient to burn off the deposit. In reality it is the fire itself that does the work and it is well to bear this in mind in using soot removers. A hot fire and sufficient excess air to burn the soot are absolutely essential, the soot remover merely reducing the ignition temperature of the deposit.

An investigation by the Bureau of Mines (Bull. No. 360) showed that metallic chlorides are the most effective agents in soot removal. In decreasing order the effectiveness of various chlorides is:

Copper chloride, lead chloride, zinc chloride and rock salt. The investigators further found that mixtures of the metal or some compound of the metal with common salt gave the same effect as the metal chloride, i.e.: zinc and common salt are as effective as zinc chloride; lead oxide (red lead) and common salt is as effective as lead chloride.

The following mixtures are all effective:

1.	Blue vitriol (copper sulate)	1 lb.
	Common salt	4 lb.
2.	Red Lead (Dry)	1 lb.
	Common Salt	5 lb.
3.	Finely divided zinc	1 lb.
	Common salt	1 lb.

Almost all of these mixtures will have a tendency to corrode flue pipes, but it is doubtful if their effect is any worse than that caused by ordinary flue gas.

There are a host of "Soot Removers" on the market, practically all of which are mixtures of the above-mentioned materials with coal dust, sawdust or other inert material.

In cleaning soot from oil burners the material may be suspended above the flame or it may be dissolved in water and the solution sprayed over the soot deposits.

Springfield, Mass. P. J. REYNOLDS
Springfield Gas Light Co.

Cupric Chloride Better Than Salt

UNDER date of Jan. 1, 1932, the U. S. Department of Commerce, Bureau of Mines, published Bulletin No. 360, "Removal of Soot From Furnaces and Flues By the Use of Salts Or Compounds." This booklet is obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10c. a copy.

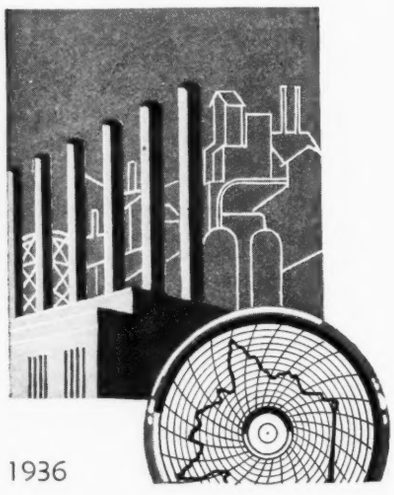
To summarize briefly the findings of this 76-page booklet: The investigators, P. Nicholls and C. W. Staples, found seven British and eight American patents taken out respectively between the dates of 1856 to date and 1892 to date, covering soot-removal compounds. The principle of operation with all such compounds was based upon the burning of the compound which produced a fume that deposited on the surface of the soot, reducing its ignition temperature from that of normal soot at about 1,200 deg. down to 1,000 deg. for common salt, the least effective compound, and to 688 deg. for cupric chloride, the most effective compound. Reduction in ignition temperature in the presence of a brisk fire would cause the soot to catch fire and burn.

Fifty-five metals and metallic salts or mixtures were tested and reduction in ignition temperature for each given. They also examined by chemical analysis the sixteen commercial soot removers sold to date in this country, and tested four typical compounds from among these and tabulated the reduction in ignition temperature accomplished in each of these.

The results with finely divided metals showed that finely divided tin reduced soot ignition temperature by 253 deg., finely divided copper by 239 deg., and an alloy of 20% copper—30% lead and 50% zinc, by 250 deg. The results with chlorides, iodides and sulphates of the above metals showed a reduction in soot ignition temperature of from 166 deg., for common salt all the way up to 512 deg. for cupric chloride.

In the summary and general conclusions there appears, among other things, two results from soot removal by use of such compounds which seem to make their use of questionable value, namely, that when the soot deposits burn, the flue pipe gets red hot. Since more fires are started by hot flues than by any other cause, there is a serious danger involved. Furthermore, the burning of the soot did not remove the ash, which had to be removed by hand scraping. Since use of these compounds by most people is principally to prevent the necessity for hand scraping, it seems that the most important consideration in favor of use of these compounds is not realized. The booklet cites in conclusion, however, "the fact that the use of compounds for removing soot has persisted for so many years indicates that some have found them worth while; the results looked for are positive, and the practice would not be continued unless it were found beneficial. On the other hand, the fact that it is not a universal practice implies that the benefits are limited.

New York, N. Y. PAUL F. NEWMAN
Standard Oil of New York



THE ENGINEER'S BOOKSHELF

Industial Power Costs

REDUCING INDUSTRIAL POWER COSTS (1935) —*By David Moffat Myers, consulting engineer. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 378 pages, 6 x 9 in. Numerous tables and diagrams. Clothboard covers. Price $4.*

For a long time the power field has needed a simple, clear and convincing presentation of the money-saving possibilities of better plants and better operation. This Mr. Myers has done superbly well, and that is why "Reducing Industrial Power Costs" is the best possible book to place in the hands of the general industrial executive who might be interested in increasing his net profits substantially by intelligent power management.

It would be a mistake to conclude, however, that Mr. Myers' book is not one for the engineer as well as for the general executive. The "trained engineer" will presumably be already familiar with many of the facts Mr. Myers presents, but we doubt if he will ever have seen them explained as clearly. And almost certainly every engineer will be reminded of important saving possibilities he had overlooked.

Finally, every power engineer, however well trained technically, must "sell" his own ideas and knowledge to the less technical general executive. Unless he is indeed a past master of this art, he can get many useful tips from this book.

As samples of Mr. Myers' approach, the first three chapters are particularly good: "Why Bother About Power?" "The Human Factor in Power and Industry." "Viewpoint—Its Economic Importance." These three chapters put everybody's feet on the same ground.

Becoming more specific in the technical direction, the succeeding chapters list 100 opportunities for rehabilitation, explain simple steam-plant losses and savings, show how instruments can work for management, show when to make or buy power and how to buy, compare oil with coal and stokers with pulverized fuel, explain the money-saving possibilities of high-pressure steam.

Other chapters cover boiler-plant modernization, elements of combustion, sources of power and prime movers, cutting costs in heating systems, air conditioning, when to purchase steam supply, the properties of steam, water power versus steam power, the elements of feedwater treatment, power facts and data. An important feature of the book is the Power-Loss Check Chart.

Arc Welding

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE.—*Published by Lincoln Electric Co., Cleveland, Ohio, Third edition, 1935. 596 pages, 714 illustrations, 6 x 9 in. Flexible fabrikoid covers. Price $1.50.*

Many *Power* readers are already familiar with the first and second editions of this book, which has filled an important practical need in the welding field. It appears to grow like Topsy, and now has close to 600 pages of practical, concentrated information.

The book is divided into eight parts, covering: Welding Methods and Equipment; Technique of Welding; Procedures, Speeds and Costs for Welding Mild Steel; Structure and Properties of Weld Metal; Weldability of Metals; Designing for Arc-Welded Steel Construction; Designing for Arc-Welded Structures; Typical Applications of Arc Welding in Manufacturing, Construction and Maintenance.

The new edition contains additional information on such subjects as qualification of welding operators, method of determining amount of current carried by electrode, flame cutting, welding of sheet metal, chrome-nickel clad steel, high tensile steels, hard facing, machine design, structural design, and also a variety of new applications. No man who uses arc welding should be without it.

Diesels

DIESEL ENGINEERING HANDBOOK (8TH EDITION)—*Edited by L. H. Morrison, editor of* DIESEL POWER. *Published by Diesel Publications, Inc., 192 Lexington Ave., New York, N. Y. 831 pages, 6 x 9 in. Many illustrations and tables. Flexible covers. Price $5.*

Forty chapters of diesel data from basic principles to maintenance and operating information are included in the eighth edition. Separate chapters discuss each engine element, each type of application, etc. It's a good job, complete in details, including much data previously published in *Diesel Power*. It openly and frankly favors the diesel, that is only to be expected, and the reader willing to allow for this will be very pleased with it. Probably this reviewer's opinion is generated by these two factors: the almost advertising tone of descriptions of individual engines, and the inclusion of diesel and accessory advertising.

As to subjects, the book covers fuel injection, combustion, engineering fundamentals, frames and cylinders, pistons and piston rings, connecting rods and pins, crankshafts and bearings, cylinder heads, valves and gears—and so on to air systems, cooling water systems, supercharging, isolation, voltage regulation, etc.

Steels

STEEL PLATES (CATALOG 135—1935). *362 pages. Published by Bethlehem Steel Company, Bethlehem, Pa. 6 x 9 in. Flexible fabrikoid covers, gold lettering and page edges. Price $1.*

If you want dependable working data on properties and performance of steel plates, this is your book. It has five subdivisions: Manufacture, Specifications, Tabulated Data and Applications; Flanged and Dished Heads; Tubes; Boiler Design, Riveted Joints, Welding, Etc.; Engineering Tables.

This reviewer was particularly interested in the dished and flanged head, tube and boiler-design data in the book.

BRIEF REVIEWS

1936 SHOW SCHEDULE (1935). *Published by Exhibitors Advisory Council, Inc., 330 West 42nd St., New York, N. Y. Price $3.* —Lists 250 major trade, industrial and professional shows and exhibits to be held in 1936, with dates and locations.

CLEVELAND'S MUNICIPAL LIGHT PLANT (1935). *Report by L. A. Quayle, chief engineer, Dept. of Public Utilities, Cleveland, Ohio, to Director of Public Utilities. 24 mimeographed pages, 8½ x 11 in., 9 charts.* —Brief history, present status and future development of municipal power system.

COAL MINING COSTS (1935). *Published by Dominion Fuel Board, Motor Bldg., Sparks St., Ottawa, Canada.* — Chart constructed on comparative basis illustrates operating costs and revenues of Canadian coal mines by districts for 1931-34.

BOILER-WATER TROUBLES AND TREATMENTS WITH SPECIAL REFERENCE TO PROBLEMS IN WESTERN OREGON (1935). *By R. E. Summers. Published as Bulletin Series No. 5 by Engineering Experiment Station, Oregon State Agricultural College, Corvallis, Oregon. 52 pages. 6 x 9 in., paper. Many charts and diagrams. Price 25¢.*

GUIDE TO APPLICANTS FOR DIRECT LOANS (1935). *Prepared by Committee on Direct Loans of National Conference of Business Paper Editors and Associated Business Papers, Inc., 330 West 42d St., New York, N. Y. 32 mimeographed pages, 8½ x 11 in. Paper. Price 25¢.*—No. 6 of series of analytical studies dealing with current national subjects of business interest.

MATTERS OF PROCEDURE UNDER GOVERNMENT CONTRACTS (1935). *By O. R. McGuire, counsel to the Comptroller-General of U. S. Published by Fidelity and Deposit Co. of Maryland, Baltimore, Md. 59 pages. 5 x 8 in., paper. Free.*—Information on regulations and laws affecting firms and individuals who do construction work or furnish supplies for the federal government.

CANADIAN MACHINERY TRADE—1934—(1935). *By Asst. Trade Commissioner Avery B. Peterson, published by Machinery Division, Bureau of Foreign and Domestic Commerce, Washington, D. C. 27 mimeographed pages. Price 10 cents.*

TRANSACTIONS OF A.S.M.E. (1935). *Vol. 57, No. 6, published by the A.M.S.E., 29 W. 39th St., New York, N. Y.*—Section two of the Transactions is devoted primarily to the life of former secretary Calvin Winsor Rice.

WHAT'S NEW IN PLANT EQUIPMENT

GAGE-PRESSURE EQUALIZER

FOR REGULATING valves, water-level controls and all other instruments subject to shock, pulsation or chatter from changes of pressure, gage-pressure equalizer is made in brass and non-corrosive bronze.

National Boiler Improvement Co., Inc., 4100 Georgia Ave., Washington, D. C.

ARC-WELDING ELECTRODE

"STAINWELD B" arc-welding electrode for 25-12 stainless steels, provides weld metal of same characteristics as steel containing 25% chromium and 12% nickel. Heavily coated, utilizing shielded-arc principle of producing welds. Weld metal said to resist stress of 95,000 lb. per sq.in. Available in $\frac{1}{8}$-in. and 3/16-in. sizes, in 11-in. lengths.

Lincoln Electric Co., Cleveland, Ohio.

METAL-CLAD SWITCHGEAR FOR LIGHT DUTY

METAL-CLAD switchgear (Type MI-9) extended to light-duty service, uses Type FK-42 removable oil circuit breaker in either of two ratings—600 amp. and 5,000 volts, or 800 amp. and 2,500 volts, both with an interrupting rating of 25,000 kva. Manually or electrically operated. Metal-clad unit has stationary and removable element, disconnecting devices, supporting structure, interlocking equipment, self-contained elevating mechanism with removable lever, bus, and interconnections.

General Electric Co., Schenectady, N. Y.

INCLOSED FAN-COOLED D.C. MOTOR

FAN-COOLED, totally-inclosed d.c. motor has external fan and shroud on commutator end. Remove one cover from bracket opening to reach brushes. Inner supporting bearing bracket cast integral with outer air shroud, has air passages between shroud and bracket, except at inspection openings.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

OIL-RESISTING PNEUMATIC HOSE

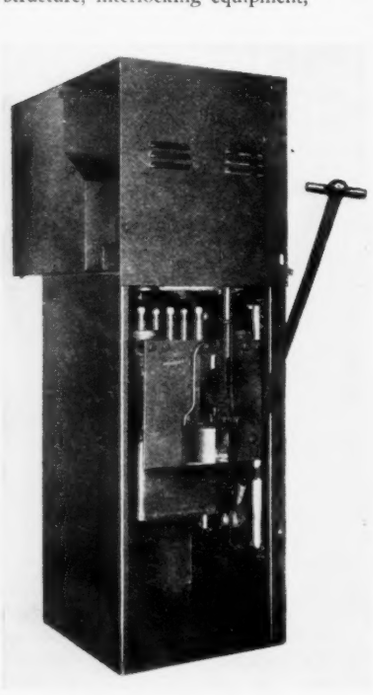
AIR HOSE to overcome effects of hot oil from air compressors, has tube which can be saturated with oil for long periods without harm. Plies are twisted cord impregnated with rubber compound.

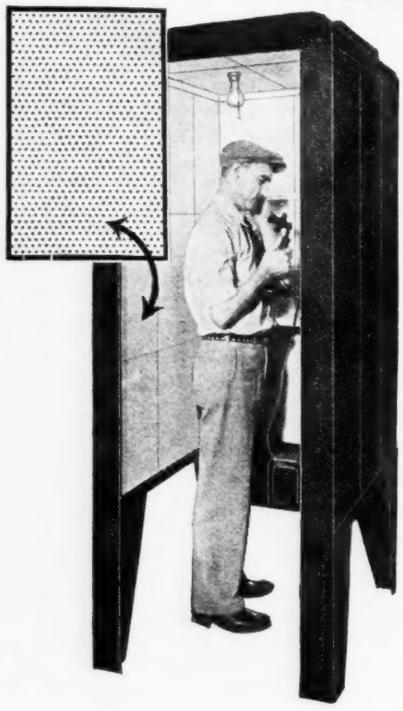
Republic Rubber Co., Youngstown, Ohio.

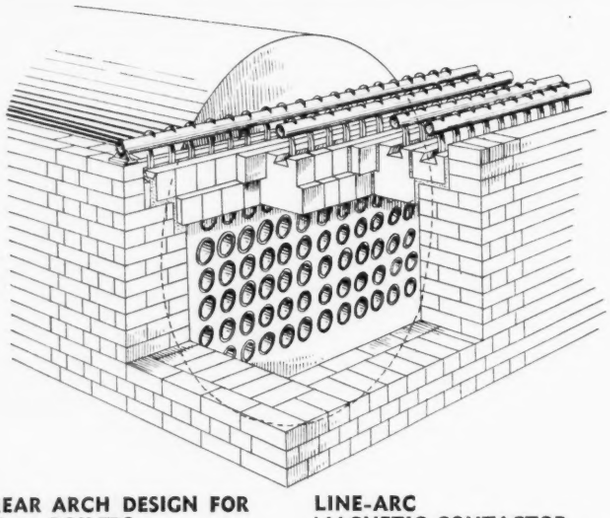
TELEPHONE BOOTH

TELEPHONE booth absorbs extraneous sounds. Interior faced with Burgess acoustic treatment, perforated metal sheets backed with balsam wool. Washable metal facing discourages pencil scribblers. No door necessary.

Burgess Battery Co., Madison, Wis.







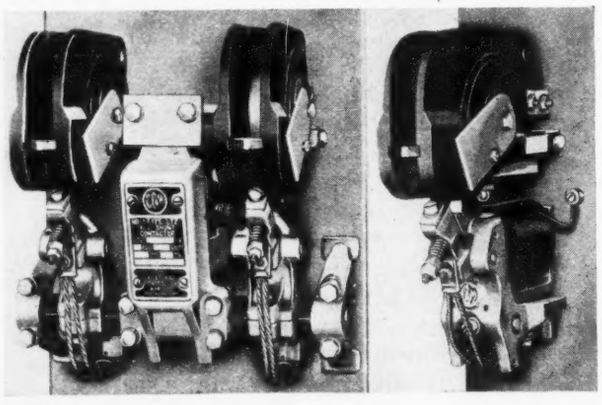
REAR ARCH DESIGN FOR H.r.t. BOILERS

STANDARD wall tiles used as rear arches on horizontal return tubular boilers in this design. Each tile individually hung by independent casting from pipe. Infiltration of excess air is prevented by placing standard 9-in. fire brick between each pair of tiles. Flat suspended arch is used to provide turbulence in gases so that all boiler tubes receive an equal proportion of hot gases. Freedom of expansion and contraction is provided.

Geo. P. Reintjes Co., Kansas City, Mo.

LINE-ARC MAGNETIC CONTACTOR

TYPE LT for d.c. and LTZ for a.c. "Line-Arc" contactors, of aluminum alloy for quick motion. No. 1, Type LTZ, 3-pole contactor, said to be able to make 650 operations per min. Cold-formed copper contacts. Arms assembled on and insulated from square steel shafts on "Oilite" self-aligning-self-lubricating bearings. "Line-Arc" principle guides arc in narrow path centered between, but not touching arc shields.

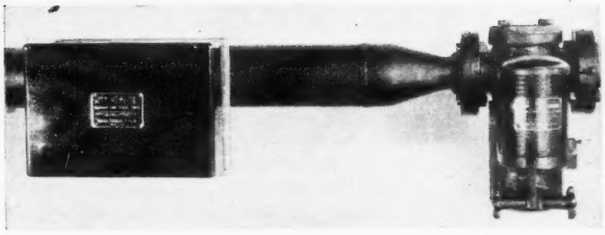


Electric Controller & Mfg. Co., 2700 East 79th St., Cleveland, Ohio.

SELF-REGULATING BATTERY CHARGER

RECTOX charger with no moving parts, maintains battery voltage at required value within plus or minus 1.75% for load variations down to 10% full-load rating, and variations in line voltage of plus or minus 10%. Consists of main, 2-winding transformer, and rectox for supplying battery charging current, together with auxiliary magnetically operated control circuits.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



ZONE CONTROL HEATING SYSTEM

CONTROLS for Tallmadge heating system have been separated into two parts, adjustable compensated pressure switch (in rectangular case) to regulate current to motors of control devices to obtain proper pressure for modulating steam flow to zone radiators. Type G pressure box for remote control regulates motor movement in Type AS or AL damper motors, Type B or C modulating zone valves. Installed on low-pressure heating steam main or riser leading to radiator orifices. Modulating zone valve, to right of pressure box, reduces steam supply from pressures over 100 lb. to fraction of an ounce for lower rates of flow through radiator orifices. Also regulates supply in accordance with load. Actuated by special electric motor.

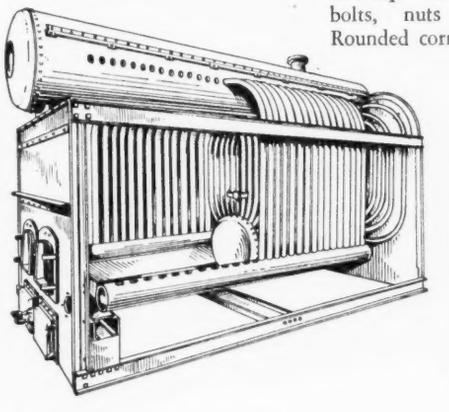
Hoffman Specialty Co., Waterbury, Conn.

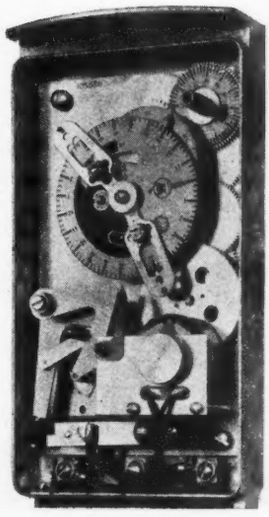
WATER-TUBE BOILER

(Correction of December, 1935, item)

TYPE "CP" completely steel-encased and insulated, has no brickwork except for front wall and bridge walls. Water-cooled furnace sides and built-in soot blower. Shipped assembled to 2,500 sq.ft., pressures 450 lb. Larger sizes assembled on job. Top ends of waterwall tubes discharge into upper drum. Lower ends terminate in headers extending from front to rear. Rear ends of headers are connected to rear end of lower drum by means of circulating tubes. Bulletin No. F8.

E. Keeler Co., Williamsport, Pa.





ASTRONOMICAL TIME SWITCH

SYNCHRONOUS motor-driven astronomical time switch in case has calendar dial driven by a hysteresis motor which runs at 600 r.p.m., and consumes approximately 1.4 watts at 120 volts. Calendar dial to which on-and-off operating arms are attached makes one revolution per day. Cams located behind calendar dial control position of on-and-off arm, and make one revolution per year.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SOLDERLESS CONNECTORS

SOLDERLESS clamp-type connectors made in equal halves of cast-to-size form. Finished surface presents number of sharp, minute projections which, when bolts are tightened, dig into copper-tube conductor and insure permanent non-slip contact. Non-ferrous bolts, nuts and lockwashers. Rounded corners at points where conductor enters or leaves prevent local stresses in conductor.

Delta Star Electric Co., 2400 Block Fulton St., Chicago, Ill.

ROTARY DISPLACEMENT METERS

$2\frac{1}{2}$ x 7 ROTARY displacement meters for line pressures up to 25 lb. per sq.in., have normal capacity of 5,000 cu.ft. per hour at 1-in. water gage differential, but maintain commercial accuracy on loads ranging from 10 to 150% of normal rating. Meter measures 22 x 14 x 15 in. Base for foundation mounting, or special bottom pipe plate for direct mounting in vertical gas line. Equipment includes differential gage and register reading in cubic feet of gas passing meter.

Roots - Connersville Blower Corp., Connersville, Ind.

BRAKE LINING

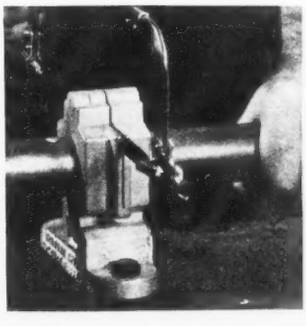
STYLE No. 900 woven and compressed brake lining for use on all heavy industrial equipment, incorporates structure of solid woven lining with wearing qualities of compressed styles. Flexible readily formed, adaptable to various speed requirements; mechanically strong; will withstand severe shock-loading.

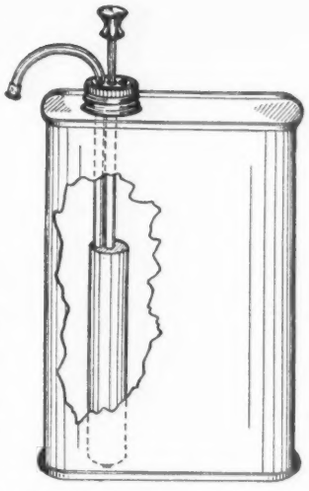
Johns-Manville, 22 East 40th St., New York, N. Y.

TUBE-SAWING VISE SET

FOR HOLDING thin wall tubing for sawing, soldering, etc., this vise consists of base with handle for clamping hinged collars, slotted for saw. Seven sizes of collars for $\frac{3}{8}$- to 2-in. diameter pipe, and special sizes for "plumbers' brass," "scratch thread," and sanitary tubing. Vise bolted to bench or carried as hand tool.

Trimont Mfg. Co., Inc., 55-71 Amory St., Roxbury (Boston), Mass.

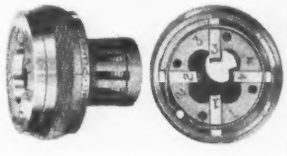




MEASURING PUMP

FOR MEASURING out small quantities of oil, glycerine and other liquids, double-acting measuring pump delivers accurately $\frac{1}{2}$ or 1 oz. of liquid with each complete stroke of pump plunger.

V. R. Hall Products Co., 9304 Amesbury Ave., Cleveland, Ohio.



ADJUSTABLE BOLT DIE HEADS

REMOVABLE bolt die heads and dies for use with "Toledo" No. 00 ratchet, are cadmium plated. Standard bolt threads or over or under adjustment of 1/64 in. obtained by loosening four die-head-cover screws and turning knurled ring.

Toledo Pipe Threading Machine Co., Toledo, Ohio.

REFRIGERANT GAS LEAK DETECTOR

"PREST-O-LITE HALIDE LEAK DETECTOR" for locating leaks in refrigerating and air-conditioning units using chemical compounds containing elements of halogen family—fluorine, chlorine, bromine, iodine. Consists of Prest-O-Lite needle valve torch handle assembly, burner which includes suction nipple for attaching rubber hose, and chimney with copper reaction plate. 5-lb. regulator must be used with "B" tank, or when hose is used with "MC" tank. Not suitable for locating leaks of any combustible gas.

Linde Air Products Co., 30 East 42nd St., New York, N. Y.

NOT MAKING BINS, BUT . . .

Assembling stator of Westinghouse 82,500-kva. Boulder Dam generator. Entire weight of generator rotor, waterwheel runner and water thrust, about 1¾ million lb. will be carried on Kingsbury thrust bearing on upper bracket

POWER LINES

World Power Conference Program Announced

Program for the Third World Power Conference to be held in Washington, D. C., Sept. 7-12, 1936, is now available in printed form from Director, Third World Power Conference, Interior Bldg., Washington, D. C. Lists officers and committee members, topics for discussion, program of Second Congress on Large Dams, instruction for preparation and submission of papers, definitions of terms and units. James H. McGraw, honorary chairman of the board, McGraw-Hill Publishing Co., Inc., publisher of *Power,* is on the committee and will be in charge of publicity.

Topics for discussion include: Power Resources, Development and Utilization; Significant Trends in the Development and Utilization of Power Resources; Organization of the Production, Processing, and Distribution of Coal and Coal Products; Organization of the Production, Refining, and Distribution of Petroleum and Petroleum Products; Organization of the Production, Transportation, and Distribution of Natural and Manufactured Gas; Organization of Private Electric and Gas Utilities; National Power and Resources Policies.

A.S.H.V.E. Meeting

American Society of Heating & Ventilating Engineers will hold its 42nd annual meeting in Chicago, Jan. 27-30, in conjunction with the Fourth International Heating and Ventilating Exposition. Results of research at U. S. Bureau of Mines and various institutions will be presented for discussion. Technical sessions will include papers on: *Study of the Conductivity of Concrete,* F. B. Rowley; *Comparative Studies of Combustion Results with Various Thermostats,* B. F. Shaw; *Saving Affected by Storm Sash,* A. P. Kratz and S. Konzo; *Heat Transfer through Finned Tubing,* G. L. Tuve; *Subjective Reactions of Human Being to Certain Outdoor Atmospheric Conditions,* C. E. A. Winslow and L. P. Herrington; *Minimum Ventilation Requirements from the Standpoint of Body Odor,* C. P. Yaglou; *Airfoil Fan Characteristics,* W. A. Rowe; *Room Surface Temperature of Glass Windows,* J. E. Emswiler and W. C. Randall; *Comfort Standards for Summer Air Conditioning,* F. C. Houghten and Carl Gutberlet; *Corrosion Studies in Steam Heating Systems,* R. R. Seeber, F. A. Rohrman and G. E. Smedberg.

Glass Textiles

Alfred Vaksdal, frequent *Power* contributor and plant engineer of Corning (N.Y.) Glass Works, will be chief liaison official for Corning with Simplex Engineering Corp. for construction of 240- by 180-ft. factory for manufacture of fibrous glass products. A boiler plant, 36 by 48 ft., will be included. Front of the building, on Tioga Ave., will be of "Pyrex" glass construction units on brick base. Immediate field of development will be thermal insulation for buildings and pipes. Air filters for air conditioning will also be made. The fact that seven Corning employees are in Newark, Ohio, studying production methods for fibrous glass has given rise to the rumor that the Corning Co. has pooled patents with Owens-Illinois Glass Co.

James H. McGraw Becomes Honorary McGraw-Hill Chairman

At a meeting of the Board of Directors of the McGraw-Hill Publishing Company, Inc., held on December 27, 1935, James H. McGraw, the Founder of the company and its head for more than fifty years, resigned as chairman of the board and was elected honorary chairman. He will remain as a member of the board.

James H. McGraw, Jr., who has been connected with the company for the past twenty years, was elected chairman of the board. He has served as treasurer and was executive vice-president and vice chairman of the board at the time of his election.

Malcolm Muir, president of the company since 1928, continues in that capacity.

A.I.E.E. Convention

Papers to be presented at the A.I.E.E. winter convention in the Engineering Societies Bldg., 33 West 39th St., New York, N. Y., Jan. 28-31, include:

"Application of a Photoelectric Cell", A. H. Lamb.
"Angle Switching of Synchronous Motors", C. C. Schutt and J. W. Dauson.
"Pull-in Characteristics of Synchronous Motors", D. R. Shoults, S. B. Crary, Jr., and A. H. Lauder.
"Mechanical and Electrical Problems in Design and Construction of Large Turbine Generators", C. M. Laffon, M. D. Ross and L. A. Kilgore.
"Power Company Service to Arc Furnaces", L. W. Clark.
"Electrical Brush Wear", V. P. Hessler.
"A Static Thermionic Tube Frequency Changer", A. Schmidt, Jr., and R. C. Griffith.
"Self-Excitation of a Frequency Converter", Oscar Hess.
"Automatic Switchgear for Mercury Arc Rectifiers", H. Bany and M. E. Regan.
"Application of Supervisory Control Equipment", S. A. Canarilis.

POWER'S History

POWER was founded in 1884 by E. P. Harris and H. M. Swetland. With it was incorporated *Steam,* which had been started by N. Hawkins in Chicago two years earlier.

In 1903 *Power* purchased and absorbed *Science and Industry,* which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trades Magazine, Home Study for Electrical Workers* and *Steam Electric Magazine.*

In 1908 it absorbed *The Engineer's Review,* of Cleveland, and *The Engineer,* of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Engineers and Power Users Magazine, Steam Engineering* and *The Mechanical Engineer.* When *The Engineer* was purchased the name of the combined paper was *Power and The Engineer.* The title was condensed to *Power* in 1911. All rights to the above titles reserved.

NEWS NOTES

AMERICAN WELDING SOCIETY has appointed a committee to develop methods of qualifying fusion welding processes and procedure for ferrous materials. Effort has been made to provide tests to determine ability of

welding process or procedure to meet adequately code requirements or welding specification. With process established operators need only submit to very brief and inexpensive check tests to determine ability to apply satisfactorily established practice.

EDGEMOOR IRON CO., Edge Moor, Del., will liquidate and distribute its assets to stockholders, according to a recommendation of the board of directors on Nov. 14. The company was established in 1869 by William Sellers, who was succeeded in 1905 by his son, William F. Sellers, under whose leadership the company became one of the outstanding U. S. boiler manufacturers.

WESTINGHOUSE ELECTRIC & MFG. CO. will celebrate Jan. 8 the 50th anniversary of its founding by George Westinghouse, with "family gatherings" in all parts of the world, to listen to a broadcast of the complete Pittsburgh program over Westinghouse's own short wave transmitter, W8XK.

FHA's modernization credit plan, which expires April 1, 1936, can only be extended by amendment of National Housing Act. Favorable action by Congress is anticipated. Loans insured during week ended November 16 reached a peak of $8,670,067 to 28,253 borrowers from banks and other leading institutions.

RUMORS intimating that municipal water-supply systems are facing a shortage due to increasing number of air-conditioning systems being installed throughout the country are baseless, according to engineers of the York Ice Machinery Corp. Practically all air-conditioning systems require water, but there is no real cause for alarm since the industry has developed special apparatus, particularly cooling towers, which can be installed for the express purpose of minimizing water consumption.

JONES & LAUGHLIN STEEL CO. has announced a $40,000,000 plan for new mills and other improvements, including a $25,000,000 strip and sheet mill to be erected in Pittsburgh works, marking the entry of the company into this line.

FEDERAL POWER COMMISSION and Central Statistical Board are planning to eliminate duplication in collection, compilation and publication of statistics relating to electric light and power industry. Each plant will file only a single report dealing with any particular subject, and only one federal agency will publish statistics relating to each of the various phases of the industry.

POLYTECHNIC INSTITUTE OF BROOKLYN (N.Y.) will repeat its course on "Diesel and Oil Engines," Tuesday and Thursday evenings, 7:45 to 9:45 P.M., starting Feb. 4. Diesel lectures will be given by J. W. Anderson, author of the text "Diesel Engines," and "Rockville Centre Reports" in this number of *Power*.

AIR-CONDITIONING-EQUIPMENT sales during 1935 amounted to more than $35,000,000, 80% greater than 1934, according to William B. Henderson, executive vice-president of Air Conditioning Manufacturers' Association.

VANCOUVER, B. C., City Council is considering a proposal from William Meehan & Co. to develop a hydro-electric plant at Cheakamus, and a $20,000,000 rayon pulp mill, whereby they would loan the city sufficient money to purchase plants and equipment of B. C. Electric Railway Co.

OBITUARIES

WILLIAM W. MILLER, 55, manager of General Electric Co.'s Industrial Department, died Dec. 22. Mr. Miller had been connected with G.E. since his graduation in 1897, except for one year when he served in the Spanish-American War.

RICHARD A. WRIGHT, 52, vice-president of General Regulator Corp. and former sales manager of Smoot Engineering Corp., New York, died Dec. 17. Mr. Wright was a private consultant for seventeen years.

COL. W. H. DOLAN, pres. and treas. of Jennison Co., Fitchburg, Mass., died Dec. 16.

WILLIAM MACGREGOR, 47, general sales manager, Carborundum Co., died Dec. 18.

ROBERT TIFFT TURNER, vice-pres. and general sales manager of Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y., died Nov. 13.

ALFRED HEBER MCINTIRE, editor and manager of "The Electric Journal," died Nov. 4.

EDWIN H. WHITNEY, superintendent of Eddy Valve Co., Waterford, N. Y., died Nov. 22.

JOHN E. SCHRIBER, engineer of Whidden Memorial Hospital, Everett, Mass., former operating engineer for Walter M. Lowney Co., Boston, died Dec. 12.

ROSCOE R. LEONARD, member of secretarial staff of A.S.M.E., and representative in Chicago, died Dec. 7.

JOHN BOETGER, 49, watch engineer, Steam Bureau, Operating Department, Brooklyn Edison Co., died Nov. 16.

EDWIN WILBUR RICE, JR., 73, honorary chairman, board of directors, General Electric Co., died Nov. 25. Pioneer of electrical developments in the U. S., Mr. Rice played a conspicuous part in development of G.E. His inventions include the cellular system of separating buses and circuits, synchronous converters, protective devices, incandescent lamps and many others. A member of many technical societies, he was president of A.I.E.E. in 1917.

PERSONALS

FRANK V. ARCHER has joined Permutit Co. as field supervisor in Kansas City, Mo.

L. R. BOULWARE has been appointed vice-president and general manager of Carrier Engineering Corp., Newark, N. J.

SYDNEY BUCKLEY has been appointed president of Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y. Herbert W. Gledhill, formerly manager of Philadelphia office, has been elected vice-president and general sales manager.

CHARLES W. E. CLARK, consulting engineer, has opened an office in Philadelphia Savings Fund Bldg., 12 South 12th St., Philadelphia, Pa.

G. S. CRANE, sales manager, and W. C. Stevens, chief engineer, have been advanced to vice-presidencies in charge of sales and engineering, respectively, for Cutler-Hammer, Inc., Milwaukee, Wis.

F. JEROME DOERFLER, who has been on the staff of *Power* for the past six months as as an editorial assistant, has been appointed assistant editor with duties related principally to mechanical production of the magazine, such as makeup, proof-reading and relations with the printer, as well as preparation of news and descriptions of new products. A printer's son, Mr. Doerfler is a recent graduate in electrical engineering from Rennselaer Polytechnic Institute and has had considerable practical experience.

W. E. S. DYER, consulting engineer, has established offices at 21 West St., Battery Park, New York, N. Y.

CHARLES W. EAST of Birmingham, Ala., office of Republic Steel Corp., has been named assistant manager of sales, pipe division, succeeding GEORGE E. CLIFFORD, recently appointed district sales manager in Los Angeles, Calif. ROBERT J. WORKING has been appointed district sales manager in Birmingham, Ala., succeeding KENNETH D. MANN, who resigned to become executive vice-pres. of Truscon Steel Co. PAUL R. JOHNSTON has been named district sales manager in Cincinnati, Ohio, succeeding Mr. Working and C. A. CHERRY has been appointed district sales manager in Buffalo, replacing THOMAS B. DAVIES, transferred to Alloy Steel Division in Massillon, Ohio.

BRENT WILEY, formerly of Westinghouse Electric & Mfg. Co., has been elected managing director of the Association of Iron & Steel Electrical Engineers, to succeed the late John Frederick Kelley.

EDWARD H. HAHL has been appointed to sales engineering staff of American District Steam Co., North Tonawanda, N. Y.

WALLACE L. HIGGINS has been appointed eastern manager of sales for Schwitzer-Cummins Co., Indianapolis, Ind.

WILLIAM A. MACY has been appointed sales manager for metropolitan New York with headquarters at 30 Church St., for Chapman Clay Co., Refractories Division, Zanesville, Ohio.

EARLE W. MCMULLEN has become director of research of Eagle-Picher Lead Co., succeeding Dr. John A. Schaeffer, who resigned to become president of Franklin & Marshall College.

DR. ELWOOD MEAD, Commissioner of Reclamation, will head a committe of engineers to develop a plan for coordinating the Columbus, Sutherland and Tri-County PWA projects in Nebraska. Other members are: J. D. Ross, R. V. L. Wright, George F. Harley, and K. Sewell Wingfield.

E. P. REXFORD has been made a member of research staff of Harbison-Walker Refractories Co., Pittsburgh, Pa.

FRANK S. SCOTT, formerly of Appalachian Coals, Inc., will direct fuel engineering service of New River Coal Co., Charleston, W. Va.

DR. LEWIS B. STILLWELL will be awarded Edison Medal for 1935 by A.I.E.E. at the winter convention in New York, Jan. 28-31.

G. G. VAN TUYL, 18927 Winslow Rd., Cleveland, Ohio, has been appointed representative for Pennsylvania Pump & Compressor Co., Easton, Pa.

B. H. WHITING has been appointed district manager in Cincinnati, Ohio, at 705 Chamber of Commerce Bldg., for the Whiting Corp., Harvey, Ill.

RUDOLPH WINTZER, former chief engineer, has been promoted to consulting engineer for Nordberg Mfg. Co., Milwaukee, Wis. Emil Grieshaber is new chief engineer.

N. O. WYNKOOP, manager of *Power*, was re-elected president of Exhibitors Advisory Council, 330 West 42nd St., New York, N. Y., at its recent annual board meeting. Other officers elected were: E. J. Billings, Babcock & Wilcox Co., vice-president, C. E. Sullivan, The Foxboro Co., secretary, R. H. DeMott, S. K. F. Industries, Inc., treasurer, and W. A. Hemming, executive secretary. The Council has since 1926 assisted exhibitors by issuing comprehensive data and information on all types of shows.

BUSINESS NOTES

AIR-HYGIENE FOUNDATION OF AMERICA, INC., Thackeray Ave. and O'Hara St., Pittsburgh, Pa., has been formed to conduct investigations and stimulate research in problems in field of air hygiene.

AMERICAN DISTRICT STEAM CO., North Tonawanda, N. Y., has secured rights to Becker condensation and steam return system feedwater pumps east of Mississippi River and in Canada.

BABCOCK & WILCOX CO., Refractories Division sales office for Southeastern district has been transferred from Atlanta to works at Augusta, Ga.

BIRD-ARCHER CO., Philadelphia, Pa., has been appointed dealer agent for General Refractories Co.

BUENSOD-STACEY AIR-CONDITIONING CO., has opened offices in Lincoln Bldg., 60 East 42d St., New York, N. Y., as a personal-service organization in air-conditioning contracting field.

REPUBLIC STEEL CORP., has moved its Cleveland, Ohio, district sales office to 920 Republic Bldg.

ELLIOTT CO., Pittsburgh, Pa., has absorbed Liberty Mfg. Co., Jeannette, Pa., and The Lagonda Mfg. Co., Springfield, Ohio. Manufacture of Liberty and Lagonda tube cleaners will be continued by Elliott Co.

PIERCE, BUTLER & PIERCE MFG. CORP. has transferred all assets and operations to Pierce-Butler Radiator Corp., 701 Nichols Ave., Syracuse, N. Y.

OCEAN ACCIDENT & GUARANTEE CORP., LTD., and associated companies in the Commercial Union Group have removed their Los Angeles office to 650 South Spring St., Los Angeles, Calif.

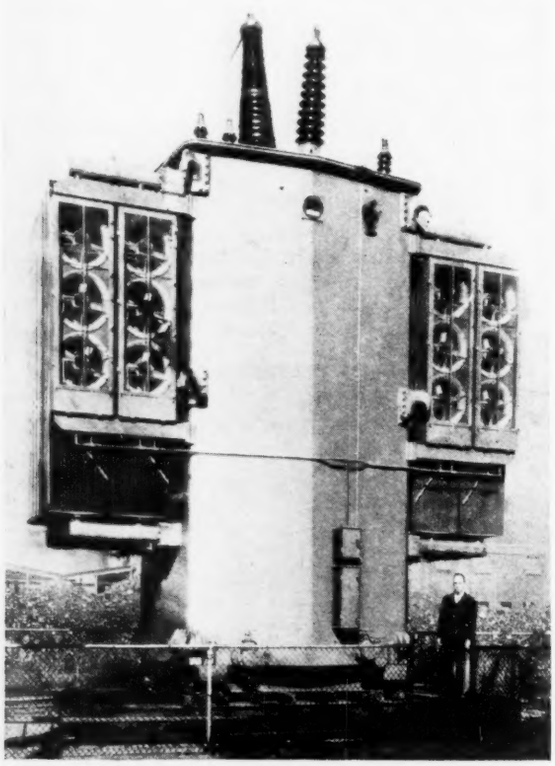
EASTERN STEAM SPECIALTY CO., INC., 125 Barclay St., New York, N. Y., has been named representative for McAlear Mfg. Co., Chicago, Ill.

HOFFMAN SPECIALTY CO., Waterbury, Conn., is now marketing Hoffman-Tallmadge zone-control heating specialties, manufactured by Webster-Tallmadge & Co.

JOHNS-MANVILLE CORP., 22 East Fortieth St., New York, N. Y., plans steam plant at proposed mill on 60 acres in Jefferson Parish, near New Orleans, La. Entire project to cost over $650,000.

WALTER H. NIESTRATH CO., 3324 S. Jefferson Ave., St. Louis, Mo., and EDWIN BALL, JR., 1105 Packard Ave., Fort Wayne, Ind., have been appointed sales representatives for Centrifix Corp., Cleveland, Ohio.

CRANE CO., Chicago, Ill., has established a Division of Research and Development under the direction of M. W. Link. A Product Engineering Dept. has been created at the Chicago Works under the vice-president of manufacture.



MILLION-DOLLAR TRANSFORMER

One of seven, this world's largest Westinghouse transformer will step down 65,000 kva. at 287.5 kv. from Boulder Dam to Los Angeles 132-kv. distribution ring. 7 tons of copper, 47 tons of electrical sheet steel, 9 tons of insulation and 53 tons of coil are in this 35-ft. transformer on 12x23-ft. base

Coal for Steam Generation Before the A.I.M.E.

Several papers on use of coal for steam generation of interest to power engineers were presented at the meeting of the American Institute of Mining Engineers at St. Louis, recently. Among them was a paper by E. G. Bailey: "Relation of Steam-Generating Equipment to Preparation, Selection and Burning of Fuel"; one by Henry Kreisinger: "Value of Coals as Steaming Fuel, as Indicated by Their Chemical and Physical Properties"; and one by E. H. Tenney: "The Future of Coal for Stationary Power."

Mr. Bailey pointed out that there are three groups most interested in the problem of generating power from coal: the power-plant owner or user wherever coal is the normal or even possible fuel, the manufacturer of coal-burning and steam-generating equipment, and the coal producer. The power-plant owner, usually upon the advice of his consulting engineer, buys equipment that is considered best adapted to meet the anticipated conditions with reference to capacity load factor, kind and price of fuel most economic to be used and efficiency and reliability he hopes to obtain. After the plant is built it devolves upon the owner to properly evaluate the different coals available and produce steam at the lowest overall cost including fuel, maintenance, operating cost, capital charges and efficiency. The most difficult part of this procedure is to evaluate properly fuels when they are dissimilar.

Manufacturers of fuel-burning and steam-generating equipment are a very important link between the fuel producers and fuel

users. They have naturally kept in close contact with their customers, the power-plant owners, and have endeavored to develop equipment to meet their wishes and requirements for whatever fuel it seemed best or easiest to burn. It should be the goal of progressive manufacturers to improve and develop furnace and fuel-burning equipment which will burn as wide a range of fuels as possible with maximum efficiency. If low-grade coal can be burned with the same efficiency as high-grade coal, then the purchaser can select the coal having the greatest B.t.u. per unit cost on a delivered price basis, with perhaps a few minor factors such as the ash disposal.

Mr. Kreisinger, in his paper, pointed out that the value of any coal for steaming purposes depends on the amount of steam made per lb. of coal, which in turn is a function of the heat content when the coal is received, the attention that must be given to the burning of the coal to get good results (which includes poking coal to make it flow from bunkers to the coal spouts, poking and cleaning the fires and the removal of refuse); cost of maintenance of grates, furnaces, pulverizers, boilers and other parts of steam-generating equipment; and outage of the steam-generating equipment for external cleaning and repair. The paper discusses the relation of such things as heat value, moisture, ash, sulphur fusibility of ash, proportion of fines, grindability and friability on the quality of coal for steaming purposes. It suggests the following method of price adjustment, assuming a basic or model coal having the following specifications: Heat value 14,000 B.t.u., moisture 2%, ash 7%, sulphur 1%, fusibility of ash 2,600 deg., fines 25%. Deduct or add from the mine price the amount proportional to 2½ times the difference in B.t.u. between the specified heat value and that received. Deduct 2 cents from the mine price for each percent above 7% ash, but no addition is to be made for less than 7% ash. Deduct 2 cents for each percent above 1% sulphur. Deduct 3 cents for each 100 deg. lower than 2,600 deg. ash-fusion temperature. Deduct or add 2 cents for every 5% fines above or below 25%.

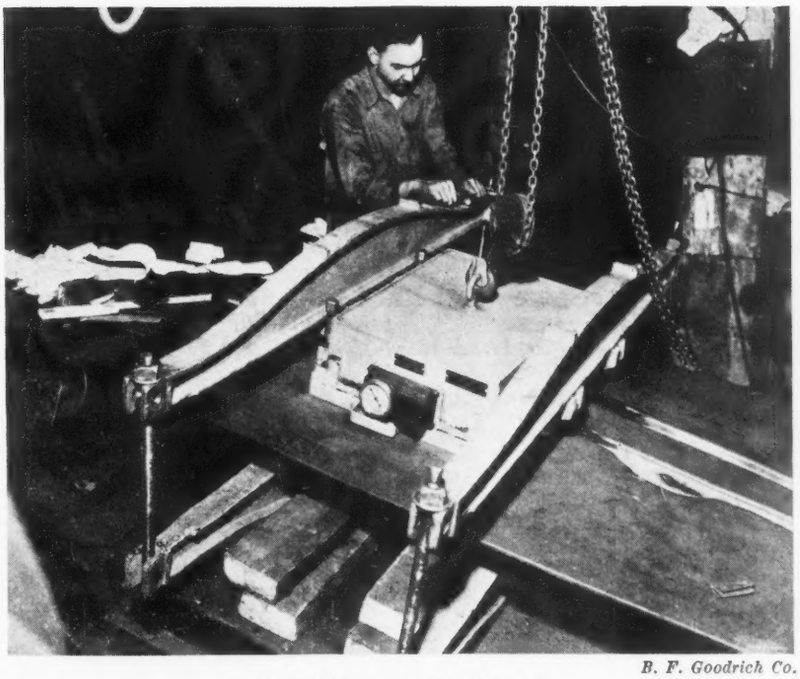
FOREIGN SHORES

VANCOUVER, B. C., is considering a recommendation from its Harbors and Utilities Committee to construct a $4,000,000 garbage disposal power plant at Thornton Park.

CONSOLIDATED GOLD ALLUVIALS, LTD., operating Wingdam deep level project in Cariboo district, has rebuilt its power plant, which now contains one 200-hp. Crossley diesel, one 300-hp., and a 137-hp. emergency unit.

GRAND FORKS, B. C., has applied to the Provincial Government for permission to build a dam to store 6,000 acre-feet of water for hydro-electric power.

GERMAN GOVERNMENT has doubled import duties on diesel oil, supposedly to encourage domestic production of oil. According to rumors, object is to decrease use of diesel, undesirable in case of war, since Germany produces only 15% of her diesel fuel, but 25% of her gasoline.



B. F. Goodrich Co.

DARNING THE DARN BELT

Lowering electrically-heated vulcanizing press on 756-ft. coal-conveyor belt at Columbia Park Station of Union Gas & Electric Co., Cincinnati, Ohio. Rubber surface was cut away from tear, fabric cleaned, and raw rubber applied over exposed surface

STRAWS

Pointing the way business winds blow

FLORENCE, ALA., Chamber of Commerce, heads project to construct and operate series of cold storage and refrigerating plants in state. Propose to build about 18 plants. Financing through Federal aid. Orlan B. Hill, Jr., public works representative.

CONN. LIGHT & POWER CO. has ordered a fourth unit (11,000 hp., 68-ft. head) for Stevenson hydro plant, on Housatonic River, bringing capacity to 36,000 hp. Waterwheel contract awarded to S. Morgan Smith, and generator to Westinghouse.

CITY HOSPITAL, Worcester, Mass., has $57,000 from PWA for addition to steam plant including boiler units and auxiliary equipment. Adolph Johnson, 16 Norwich St., architect; Edward J. Tucker, City Hospital, engineer.

HOLYOKE WATER POWER CO., Holyoke, Mass., plans an addition of steam-generating units and accessories. Equipment awards soon. Cost over $200,000. Arthur L. Nelson, 31 St. James Ave., Boston, Mass., consulting engineer.

BUREAU OF YARDS & DOCKS, NAVY DEPT., Washington, D. C., receives bids until Jan. 15 for extensions in pumping plant and fuel piping system at Naval Fuel Depot, Pearl Harbor, T. H., including motor-driven pumping machinery and auxiliary equipment (Specification 7447).

UNITED ENGINEERS & CONSTRUCTORS, INC., 1401 Arch St., Philadelphia, Pa., have been retained by United States Pipe & Foundry Co., to construct a plant at Chattanooga, Tenn., from plans prepared under Edward Hering, chief enginer of latter company.

South and Southwest

PARIS, TENN., has voted $300,000 for electric plant in 1936. List of equipment being arranged. J. S. Watkins, Citizens' Bank Bldg., Lexington, Ky., consulting engineer.

TVA, Knoxville, Tenn., has awarded contracts to Baldwin-Southwark Corp., Philadelphia, Pa., subsidiary of Baldwin Locomotive Works, and to General Electric Co., Schnectady, N. Y., for hydraulic turbine and generator, respectively, at Wheeler Dam. Units rated at 45,000 hp., will duplicate equipment previously awarded to the two companies. Turbine will cost $315,500; generator, $415,000. Delivery in 1936.

JACKSONVILLE, FLA., is arranging $50,000 through Federal aid for power-plant extensions. Department of Public Utilities, Ernest E. Anders, commissioner, in charge.

TVA has announced that work will start at once on a new $29,000,000 dam across the Tennessee river, 9 miles downstream from Guntersville, Ala.

NEW MEXICO municipalities plan steel-pipeline natural-gas distributing systems. Las Cruces will spend about $185,000 for distribution station and line for connection with Western Gas Co. Mexico Engrg. Co.,

Albuquerque, engineer. Deming will use $40,000 for distribution lines and operating facilities; C. B. Morgan, Deming, engineer.

ROEGLIN PROVISION CO., 1009 East Commerce St., San Antonio, Tex., plans cold storage and refrigerating plant for 1-story meat-packing house. Project will cost over $65,000. Marvin Eickenroht, Maverick Bldg. architect; L. D. Royer, Smith-Young Tower Bldg., consulting engineer, both of San Antonio.

MOORELAND, OKLA., will soon break ground for municipal plant to cost about $35,000. Benham Engrg. Co., Perrine Bldg., Oklahoma City, Okla., consulting engineer.

CHARLES A. ZILKER, 519 West Ashbey Place, San Antonio, Tex., plans 1-story boiler house at proposed brewery at Orange and Cochran Sts. Project will cost about $150,000. Operating company being formed by Mr. Zilker.

POLLOCK PAPER BOX CO., Dallas, Tex., has installed an 800-hp. Meriam rebuilt diesel engine.

Midwest

CONSUMERS POWER CO., Jackson, Mich., plans welded steel pipeline from gas field in Mecosta and Montcalm Counties to Lansing, Mich., and vicinity, to furnish natural gas to 26 municipalities. Line will be about 60 miles long and is estimated to cost $500,000, with distribution lines and facilities. Work will start early in 1936.

MUNICIPAL UTILITY DISTRICT, Indianapolis, Ind., plans steel pipeline for belt system natural-gas supply in industrial area, and replacements. $750,000 has been secured through Federal aid for this and other expansion in gas distribution system.

SAVANNAH ELECTRIC & POWER CO., Savannah, Ga., has awarded contracts to General Electric Co., Schenectady, N. Y., for 7,500-kw. turbine-generator and to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for condenser and accessory equipment. Stone & Webster Engrg. Corp., 49 Federal St., Boston, Mass., consulting engineer.

STELLA CHEESE CO., Campbellsport, Wis., plans extensions in boiler plant to include generating unit for factory including diesel-generator and auxiliary equipment. Ralph W. Richardson, New York Bldg., St. Paul, Minn., consulting engineer.

HIRAM, OHIO, inaugurated service at its new municipal electric plant, Dec. 6, the first such station in the State to be completed with a Federal loan and grant. An appropriation of $34,000 was secured.

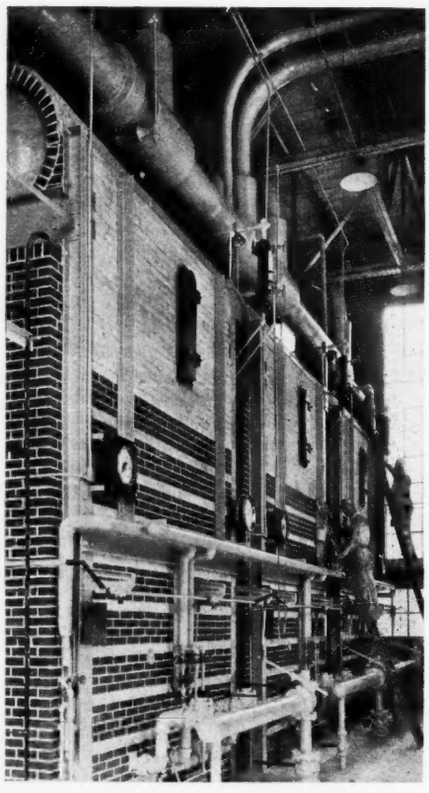
CONVENT OF BENEDICTINE SISTERS, Covington, Ky., board of directors, plans steam plant with two boilers, stokers and auxiliary equipment. Cost close to $50,000. Howard McClorey, Gerke Bldg., Cincinnati, Ohio, architect; William D. Ehlers, 3523 Pape Ave., Cincinnati, consulting engineer.

GULF STATES CREOSOTING CO., Hattiesburg, Miss., plans boiler plant in connection with creosoting works near Wilmington, N. C., where 200 acres have been secured. Project will cost over $65,000.

MARSHALL, MO., plans extensions in municipal electric plant, to cost about $150,000. Financing through Federal aid. Henrici-Lowry Engrg. Co., 114 West Tenth St., Kansas City, Mo., consulting engineer.

S. D. STATE BOARD OF EDUCATION, Pierre, S. D., is arranging $55,000 appropriation for steam plant at State Training School, Plankinton, S. D., to include two 1,000-sq.ft. boilers, one 250-sq.ft. boiler, stokers and auxiliary equipment. Walter J. Dixon, Woelfel Bldg., Mitchell, S. D., architect; Charles A. Trimmer, State House, Pierre, state engineer.

AETNA PIPELINE CO., and MORLEY NATURAL GAS CO., Morley, Mich., plan natural-gas pipelines at Morley and vicinity. First noted will build welded steel line from field in Aetna and Winfield Townships, Mecosta County, Mich., for bulk supply to Morley Natural Gas Co., affiliated interest, which will build distributing plant and distribution system. Entire project to cost over $100,000.



PWA FOR THE SICK

Plant of the Arkansas State Hospital near Benton receives final coat of paint, concluding improvements made through PWA allotment of $1,769,000

MID-STATES INDUSTRIAL CORP., 2401 Eleventh St., Rockford, Ill., parent company of Rockford Power Mach. Corp., has taken over The Swords Co., concluding the latter company's operation under section 77-B of the Bankruptcy Act.

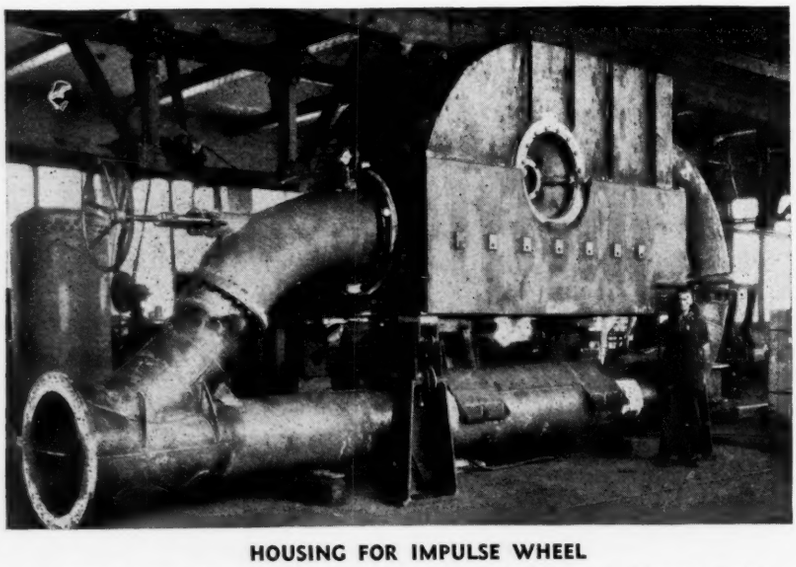
STANBERRY, MO., has awarded Fairbanks, Morse & Co., Chicago, Ill., contract for diesel-generator units and auxiliary equipment for municipal electric plant. Station will cost approximately $70,000. Henrici-Lowry Engrg. Co., 114 West Tenth St., Kansas City, Mo., consulting engineer.

THREE MINNESOTA CITIES have been granted a total of $133,100 for the construction or improvement of municipal power plants, by PWA. They are, Luverne, $19,700; Moorhead, $37,400; and Hutchinson, $76,000, the latter for a diesel-electric plant and distribution system.

MOORHEAD, MINN., plans extensions in municipal electric plant comprising boiler and accessories, stoker, ash-handling and other machinery. $120,000 will be arranged. Ralph D. Thomas, 1200 Second Ave., South, Minneapolis, Minn., consulting engineer.

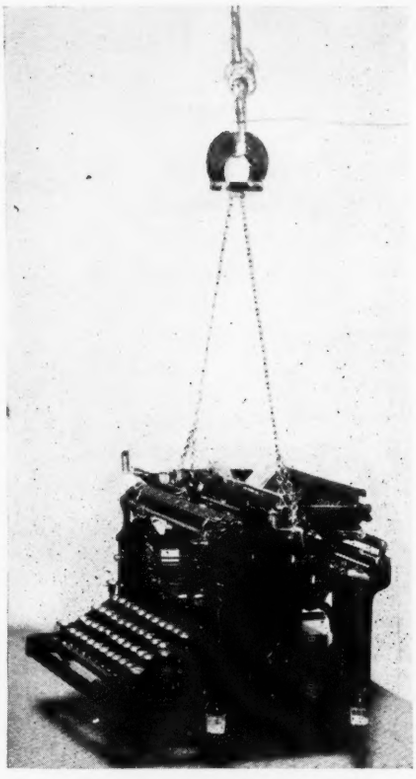
BLISSFIELD, MICH., plans improvements in municipal electric plant, to cost about $65,000.

ROBERTS & OAKE, South Racine Ave., Chicago, Ill., meat packers, plan steam power house at branch plant at Marshalltown, Iowa, to cost about $50,000. W. H. McCormack is local manager.



HOUSING FOR IMPULSE WHEEL

Nozzle connections and wheel housing for a 2,500-hp., S. Morgan Smith, double-jet, impulse wheel built for Caramanta Mining Co., Bogota, Columbia. This unit is to operate under 280-ft. head at 327 r.p.m. The entire structure including the wheel housing is built by welding, with the exception of the two pipe sections supporting the nozzles



GRIP OF STEEL

Alnico magnet, cast alloy iron, finished by grinding, has no difficulty holding up standard typewriter. Simonds Saw and Steel Co., Lockport, N. Y., has been licensed by G.E. to manufacture and sell magnets of the new alloy

GLIDDEN CO., Cleveland, Ohio, plans steam plant at proposed paint and varnish manufacturing plant on Houston Ship Channel, Houston, Tex., where site has been secured. Factory will comprise group of units, to cost close to $300,000.

WOODSTOCK, ILL., plans extensions in municipal electric plant, including 1-story addition, boiler units and accessories as well as switchboard and other equipment. C. K. Austin, superintendent at plant.

DEXTER CO., Fairfield, Iowa, manufacturer of electric washing machines, etc., has authorized 1-story boiler plant at factory, about 40 x 65 ft., with boiler units and auxiliary equipment. Cost about $35,000.

SUTTON, NEB., proposes rebuilding of municipal electric plant, damaged by fire. Loss close to $100,000.

WISCONSIN POWER & LIGHT CO., Madison, Wis., plans addition to artificial gas plant at Fond du Lac, Wis. Considerable water-gas equipment will be installed to cost about $150,000, of which about $135,000 will be for machinery. E. J. Kallevang, chief engineer; Fred H. Hainer, gas engineer.

BERGHOFF BREWING CORP., Fort Wayne, Ind., plans extensions in power house engine division to cost about $100,000. F. B. Evans, executive vice-president.

WHITE TAIL PUBLIC POWER & IRRIGATION DISTRICT, Keystone, Neb., recently organized, care of Robert Fulton, Lincoln, Neb., engineer, has State approval for hydroelectric power and irrigation project to include power dam on White Tail Creek, about 2 miles from Keystone, hydroelectric station and transmission line. Initial $77,500 being arranged.

INDIANA UNIVERSITY has made the following awards for additions to its power plant: boilers, Vogt Machine Co., $14,760; stokers, Illinois Stoker Co., $17,695; foundations, E. A. Corson, $4,900; turbine generation, Westinghouse Electric & Mfg. Co., $42,765; chimney repairs, H. R. Hernicke Co., $772; miscellaneous auxiliaries, Freyn Bros., $13,345; generator power and electrical connections, Sanborn Electrical Co., $9,344.

MUNICIPAL LIGHT, HEAT & POWER CO., Huntington, Ind., organized by James F. Bippus, Huntington, formerly owner of Huntington Light & Fuel Co., and associates, is planning a steam-electric plant.

FULTON, MO., plans steel pipeline and distributing plant early in 1936 to cost $60,000. Municipality contracted with Panhandle Eastern Pipeline Co., Kansas City, Mo., for supply. Inland Engrg. & Management Co., Security Bldg., St. Louis, Mo., consulting engineer.

AMERICAN SERVICE CO., North Cedar St., Nevada, Mo., plans early addition to ice-manufacturing and refrigerating plant, to cost about $45,000. A. S. Bitner, manager.

BLATZ BREWING CO., 3109-19 Southwest Blvd., Kansas City, Mo., plans refrigerating plant at brewery early next spring to cost over $40,000, with equipment. O. J. Cheely, general manager.

BUREAU OF RECLAMATION, Denver, Colo., awarded contract to Baldwin-Southwark Co., Philadelphia, Pa., for two 115,000-hp. hydraulic turbines for Boulder Dam. Will bring capacity up to 745,000-hp. of ultimate 1,845,000 hp.

YANKTON, S. D., is arranging Federal financing of $600,000 for municipal electric plant, and will proceed as soon as fund is available. Buell & Winter Engrg. Co., Insurance Exchange Bldg., Sioux City, Iowa, consulting engineer.

West Coast

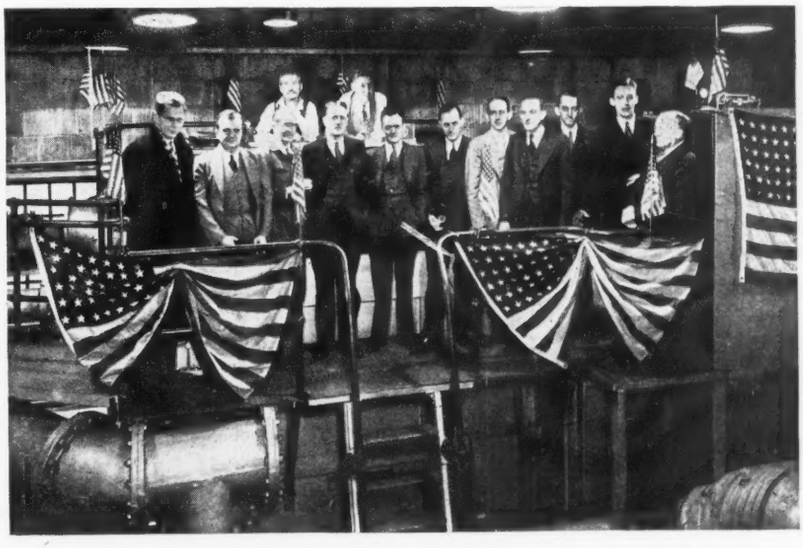
SIERRA MADRE-LAMANDA CITRUS ASSN., Sierra Madre, Calif., plans precooling plant on Foothill Blvd., Pasadena, Calif. Construction to cost about $40,000. Herbert A. Hamm, 579 North Holliston Ave., Pasadena, engineer.

METROPOLITAN WATER DISTRICT, 306 West Third St., Los Angeles, Calif., receives bids until Jan. 14 for electric pumping plant at Iron Mountain, near Rice, Calif., for Colorado River Aqueduct. (Specifications 136). Contract let to Winston Bros. Co., Title Guarantee Bldg., Los Angeles, and William C. Crowell, 495 South Broadway, Pasadena, Calif., joint bidders, for construction of Gene plant and inlet works.

PALO ALTO, CALIF., Board of Public Works, is arranging election to vote bonds for $360,000, to supplement $218,000 Federal grant for extensions in municipal plant. Four diesel-generator units will be installed, with fuel-oil storage system and auxiliary facilities. Lester S. Ready, Rialto Bldg., San Francisco, Calif., consulting engineer.

INDUSTRIAL FUEL SUPPLY CO., 810 South Flower St., Los Angeles, Calif., has authorized welded steel pipeline from gas field at Mountain View, Calif., to connect with present system, about 22 miles. Construction under Macco-Robertson, Ltd., Clearwater, Calif., to cost about $200,000.

SPOKANE, WASH., has low bid from Allis-Chalmers Mfg. Co., Milwaukee, Wis., for three 1,625-kva. generators and accessory equipment for Upriver station for municipal water department, at $157,300. Same company has also tendered low bid for three hydraulic turbines, automatic adjustable-blade propeller type, with governors and auxiliaries, at $129,450, and is scheduled to receive award on both contracts.



PROGENITOR OF TURBINES

Inaugurating tests on ⅛-scale model of 115,000-hp. turbines for Boulder Dam at Eddystone plant of I. P. Morris Div. of Baldwin-Southwark Corp. Output and efficiency can be easily stepped up by formulas to determine performance of large units

I RESOLVE . . .

IT'S New Year's Day, and the family around me are busily proclaiming their resolutions for 1936, and asking for mine. I thought my only one would be to resolve to make no resolutions, for resolutions are like promises—they're only made to be broken. But I got to thinking about it again, and I have at least one more.

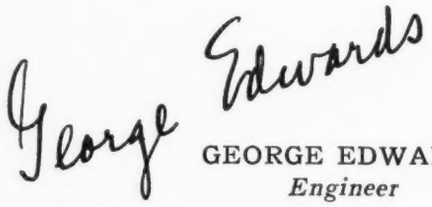
Our primary needs as individuals and as a nation, I think, are fewer resolutions and more resolution, fewer decisions to do something and more actual doing of it. In other words, we need more of what the professors call intestinal fortitude, and what I call guts.

Let's resolve for 1936 to do a few of the things we know should be done, and which we haven't done thus far because we lack gumption. Most people hate to "stick out their necks," and I suppose engineers are just like other people. But it pays big dividends to go out of the beaten track if you're certain there's sense to it. A few years ago, everybody was bemoaning the passing of the gas engine and the steam engine. "Too inefficient," they said. Well, for corpses, they're both pretty lively. Several new companies are building gas engines, and you don't build many of something you can't sell. And in Mid-December, I saw a big 2-page ad on steam engines, and nobody spends money advertising something there isn't any use for. It seems that maybe some of the old timers who stuck to their guns and said there was a future for engines were right. Natural gas has helped the gas engine, and better understanding of byproduct power profits is helping the steam engine.

Those are examples of straight thinkers who stood their ground when the tide was all the other way, something that takes as much guts as leading the way to something new. In either case, if you're sure you're right, it's worth doing.

Tom Jones figures a diesel will help his plant, but Bill Blair has a similar plant and hasn't put one in. So Tom holds off, hoping Bill will try it first. Or Tom figures maybe higher pressures would be advisable, including a new "top." But Bill hasn't done it, so Tom doesn't. The net result is stagnation, because neither will take a lead.

But I still believe the old law of survival of the fittest holds good, and facing today's modern competitive conditions, you've either got to go ahead or you'll slip backwards; you can't stand still. Competition is eliminating the unfit, cutting and weeding out the boys who are afraid to back up their opinions by doing something. This isn't true only in power plants, it's true all through business, through economics, through politics. With the upturn coming on, and new demands for power, it behooves us all to adopt the old Boy Scout slogan, "Be Prepared." And if preparedness involves leading the pack, then we've got to lead it. We've got to be the men out in front.



GEORGE EDWARDS
Engineer